Inorganic Chemical Constituents and Physical Characteristics

The major objectives of the inorganic-chemical sampling were to determine (1) the current ground-water conditions in the aquifer, (2) the changes (if any) in water quality during the 15-year period since wells were sampled in the aquifers in the study area by Buller (1978), and (3) whether ground water meets New York State drinking-water standards. Understanding the current relation between ground-water chemistry, hydrology, and land use in the Cortland county glacial aquifer system is necessary to better understand the effects that future changes in land uses may have on the aquifer.

Chemical quality of ground water is generally influenced by several factors: (1). the chemical composition of the precipitation that recharges the aquifer;(2) chemical reactions as the recharge passes through the unsaturated zone; (3) chemical reactions which occur between the matrix material and ground water in the aquifer;(4) residence time (the amount of time it takes the recharge to pass through the matrix); (5) land use above the aquifer; and (6) ground-water flow direction and rate.

Except for the unconfined part of the aquifer that is contaminated by TCE, chemical analyses of ground-water samples collected during April and September 1990 (table 7) indicate that the quality of water in the study area, generally meets New York State drinking-water standards. Concentrations of some constituents in some wells did slightly exceed the drinking-water standards.

Table 7.--Minimum, maximum, mean, median, and interquartile range of concentration or value for selected constituents or properties of ground-water samples collected during April and September 1990 from the Otter Creek-Dry Creek aquifer. [Values are in milligrams per liter, unless otherwise noted, mS/cm = microsiemens per centimeter, mg/L = micrograms per liter]

Constituent or property	Number of samples	Minimum	Maximum	Mean	Median	Interquartile range	
						25th	75th
Depth	86	14	255	55	47	34	67.00
Alkalinity (as $CaCO_3$)	101	62	312	191	196	167	220
pH	60	6.9	8.9	7.7	7.7	7.6	7.8
Specific conductance	60	257	3,850	673	592	513	705
Phosphorus, total as PO_4	59	.01	1.29	.44	.43	.12	.68
Nitrate as N	59	<.01	12	4.1	4.3	2.4	5.6
Chloride	69	5.0	274	52	38	28	61
Sodium	89	4.8	530	37	23	15	39
Potassium	40	.2	8.3	1.7	1.4	1.0	2.0
Calcium	30	.1	780	94	79	72	89
Nitrite + nitrate as N	10	.10	9.9	4.4	4.6	3.4	5.6
Magnesium	30	6.0	39	15	14	14	16
Sulfate	30	17	25	22	23	21	24
Silica	30	.55	14	7.2	7.4	6.7	7.9
Barium	30	29	290	77	62	50	74
Berylium	30	.50	1.5	.55	.50	.50	.50
Cadmium	30	< 1	3.00	1.10	< 1	< 1	< 1
Chromium	30	< 5	15	5.3	< 5	< 5	< 5
Cobalt	30	< 3	9	3.3	< 3	< 3	< 3
Copper	30	< 10	50	13	< 10	< 10	< 10
Iron	30	< 3	7,900	334	16	10	38
Lead	30	10	30	11	10	10	10
Manganese	30	< 1	3,600	206	16	4	72

Specific Conductance

Specific conductance is a measure of the capacity of water to conduct an electrical current, and is related to the type and concentration of ions in solution. Specific conductance is affected by precipitation and such chemical and physical reactions as adsorption, ion exchange, oxidation, and reduction. Specific conductance of water samples collected during April 1990 ranged from 257 to 1,440 µS/cm, with a median value of 544 µS/cm (table 8). During the September 1990 sample collection, specific conductance values ranged from 288 to 3,850 µS/cm, with a median of 611 µS/cm (table 9). Median values for specific conductance were not significantly different between the two sampling rounds, nor were they significantly different from the median value of 440 µS/cm for samples collected in 1976. Median values of specific conductance for the 1990 samplings seemed to be slightly higher than those for other aquifer in upstate New York (Miller and others, 1988).

Table 8.--Minimum, maximum, mean, median, and interquartile range of concentration or value for selected constituents or properties of ground-water samples collected during April 1990.
[Values are in milligrams per liter unless utherwise noted, mS/cm = microseimens per centimeter, ft = feet]

Constituent or property	Number of samples	Mini-mum	Maxi-mum	Mean	Median	Interquartile range 25th	75th
Depth (ft)	43	14	255	55	45	28	67
Depth to water surface (ft)	40	3.3	61.6	15.5	11.5	7.2	18.2
Depth below water table (ft)	32	4.3	247	39.7	27.2	17.6	45.5
Alkalinity (as $CaCO_3$)	59	62	265	182	190	154	212
pH	28	7.2	8.4	7.7	7.6	7.5	7.7
Specific conductance	28	257	1,440	581	544	477	660
Phosphorus, total as PO_2	59	.01	1.29	.44	.43	.12	.68
Nitrate as N	59	.1	12	4.1	4.3	2.4	5.6
Chloride	59	5.0	274	52	37	28	61
Sodium	59	5.0	204	29	22	14	35
Potassium	59	.15	8.3	1.7	1.4	1.02	2.0

Table 9. Minimum, maximum, mean, median, and interquartile range of concentration or value for selected constituents or properties of ground-water samples collected during September 1990
[Values qre in milligrams per liter unless otherwise noted, mS/cm; microsiemens per centimeter, ft.; feet. mg/L; micrograms per liter].

Constituent or property	Number of samples	Mini-mum	Maxi-mum	Mean	Median	Interquartile range 25th	75th
Well depth (ft)	43	14	217	55	48	34	67
Depth to water surface (ft)	29	5.5	72.8	22.9	17.5	13.1	28.0
Depth below water table (ft)	28	2.5	207.3	33.6	22.4	14.6	35.7
Specific conductance	32	288	3,850	753	612	555	796
pH	32	6.9	8.9	7.7	7.7	7.6	7.8
Alkalinity (as $CaCO_3$)	42	104	312	204	202	187	224
Nitrite + nitrate as N	40	.10	9.9	4.4	4.6	3.4	5.6
Calcium, dissolved	30	13	230	82	79	74	90
Magnesium, dissolved	30	6.0	39	15	14	14	16
Sodium, dissolved	30	4.8	530	54	28	18	47
Chloride, dissolved	10	21	79	47	39	30	70
Sulfate	10	17	25	22	23	21	24
Silica, dissolved	30	.55	14	7	7.4	6.7	7.9
Barium, dissolved (µg/L)	30	29	290	77	62	50	74
Berylium, dissolved (µg/L)	30	.50	1.5	.55	.50	.50	.50
Cadmium, dissolved (µg/L)	30	< 1	3	1.10	< 1	< 1	< 1
Chromium, dissolved (µg/L)	30	< 5	15	5.3	< 5	< 5	< 5
Cobalt, dissolved (µg/L)	30	< 3	9	3.3	< 3	< 3	< 3
Copper, dissolved (µg/L)	30	< 10	50	13	< 10	< 10	< 10
Iron, dissolved (µg/L)	30	< 3	7,900	334	16	10	38
Lead, dissolved (µg/L)	30	10	30	11	10	10	10
Manganese, dissolved (µg/L)	30	< 1.00	3,600	206	16	4	72

pH

The pH of a solution is a measure of the effective hydrogen ion concentration. The primary influence on pH is the interaction of soil and rock molecules with gaseous and dissolved carbon dioxide, bicarbonate, and carbonate ions. pH in the study area ranged from 7.2 to 8.4 with a median value of 7.6 for the April sampling and from 6.9 to 8.9 with a median value of 7.7 for the September sampling. These median values indicate that the water in the study area is slightly basic.

Alkalinity

Alkalinity is a measure of the capacity of water to neutralize an acid by chemical buffering. In most waters, alkalinity is caused primarily by the presence of bicarbonate (HCO_3) and carbonate (CO_3) ions. Median values for alkalinity in the study area were 190 mg/L during the April sampling and 202 mg/L for those collected in September. These values are in the range of most ground water in the state.

Chloride and Sodium

Potential sources of chloride and sodium in ground water include road deicing salt, septic tank effluents, dissolution of sodium bearing minerals within the aquifer. Also, in some places, mineralized ground water in bedrock that may discharge into sand and gravel aquifers. Elevated concentrations of chloride are generally found in ground water near major roads that are heavily salted. Median concentrations of chloride were 37 and 39 mg/L, respectively, for the April and September samplings. Only one well, well 177 at the Cortland County office building, sampled during April 1990, with a chloride concentration of 274 mg/L, exceeded the New York drinking water standard for chloride of 250 mg/L .

Based on chloride concentrations of ground water in wells at the Cortland water works, the trend of increasing chloride concentrations noted in the previous report on Cortland County (Buller, 1978), has continued (fig. 27). Although still well below the New York State standards for drinking water,

chloride concentrations are significantly higher (at the 95-percent confidence level) than in 1976.

FIGURE 27 NEAR HERE

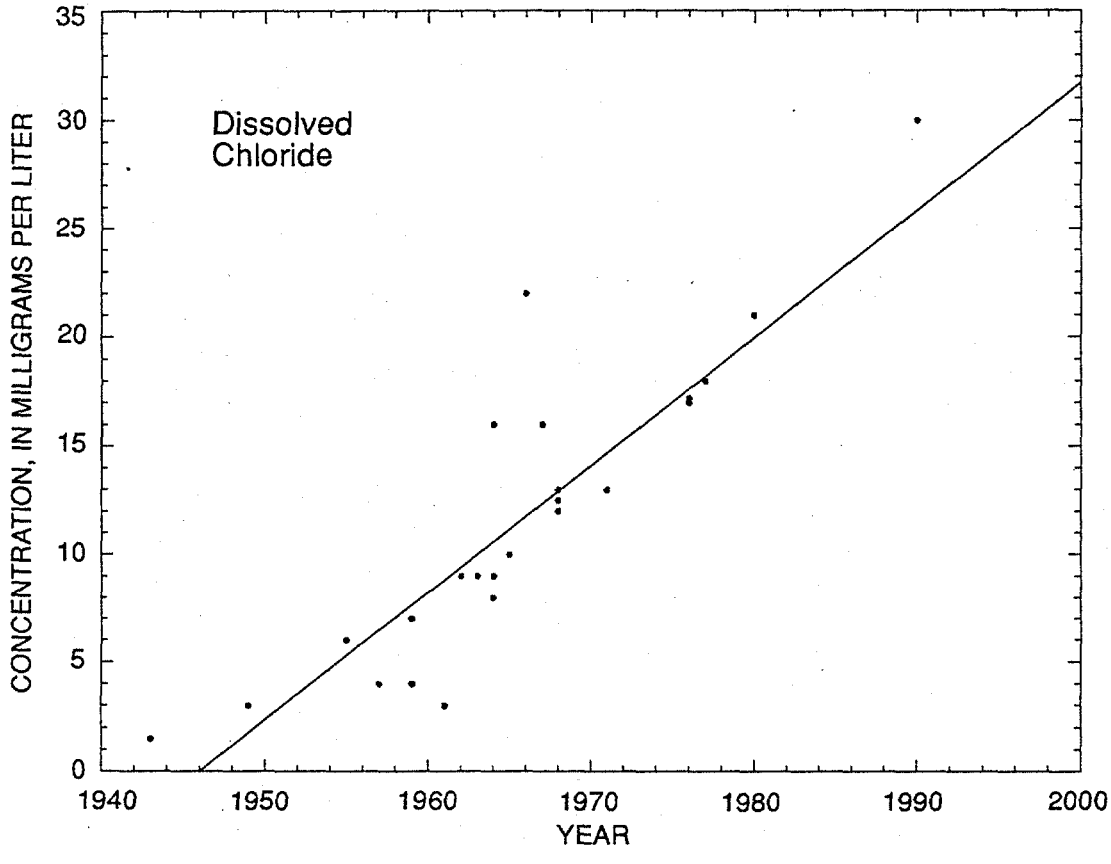

Figure 27.– *Dissolved chloride concentrations in ground-water from wells at the Cortland Water Works, for the periods 1943-76, 1980, and 1990.*

Based on chloride concentrations, vertical diffusion seems to have occurred throughout the aquifer. Median concentration of chloride was 30.5 mg/L in wells where the depth of the well below the water table is greater than 22.5 ft, while the median chloride concentration was 39.0 mg/L in shallow wells where the depth of the well below the water table is less than 22.5 ft. A chloride concentration of 28.0 mg/L was noted in a sample from well 306 which is 255 ft deep. Chloride concentrations are generally less than 40 mg/L in the western part of the study area, except for a small localized plume at the north end of the municipal airport runway, defined by a concentration of 80 mg/L in well 330. Concentra-

tions generally range from 40 to 80 mg/L in the central part of the aquifer and from 40 to 120 mg/L in the east part of the of study area. Figure 28, based on analysis of samples collected in April of 1990 shows the approximate chloride distribution in the unconfined aquifer.

FIGURE 28 NEAR HERE

Dissolved sodium concentrations in the study area ranged from 4.8 mg/L to 530 mg/L with a median value of 27.5 mg/L. Although no standard has been established for sodium, the U.S. Environmental Protection Agency (1976) recommends less than 20 mg/L in drinking water for people on sodium restricted diets. Of the 30 wells that were sampled during September 1990, sodium concentrations exceeded the 20 mg/L EPA recommended limit in 20 of the wells.

Trace Elements

Trace elements usually occur naturally in very small concentrations, but industrial processes and urbanization may increase their abundance in the hydrologic system, which can seriously degrade water quality. Except for iron and manganese, trace elements found in ground water in the study area did not exceed drinking-water standards. Iron and manganese concentrations are usually considered together, with drinking-water standards indicating that concentrations of each separately or together cannot exceed 300 mg/L. Concentrations of iron and manganese exceeded the 300 mg/L limit in 7 of the wells sampled during September 1990. Median concentrations of iron and manganese were 16 mg/L each. Very high concentrations of iron and manganese, 7,900 mg/L and 3,600 mg/L, respectively, were found in water from well 365 in the east part of the study area. Well 365 is at an abandoned gas station and rusting underground gasoline storage tanks may be the source of the unusually high ironand manganese concentrations.

Nitrogen

Nitrogen, which comprises about 80 percent of the atmosphere, usually occurs in nature in combination with other elements. It is a common degradation product of organic wastes. Nitrate sources include the decomposition of organic nitrogen that is introduced to the soil by nitrogen-fixing plants

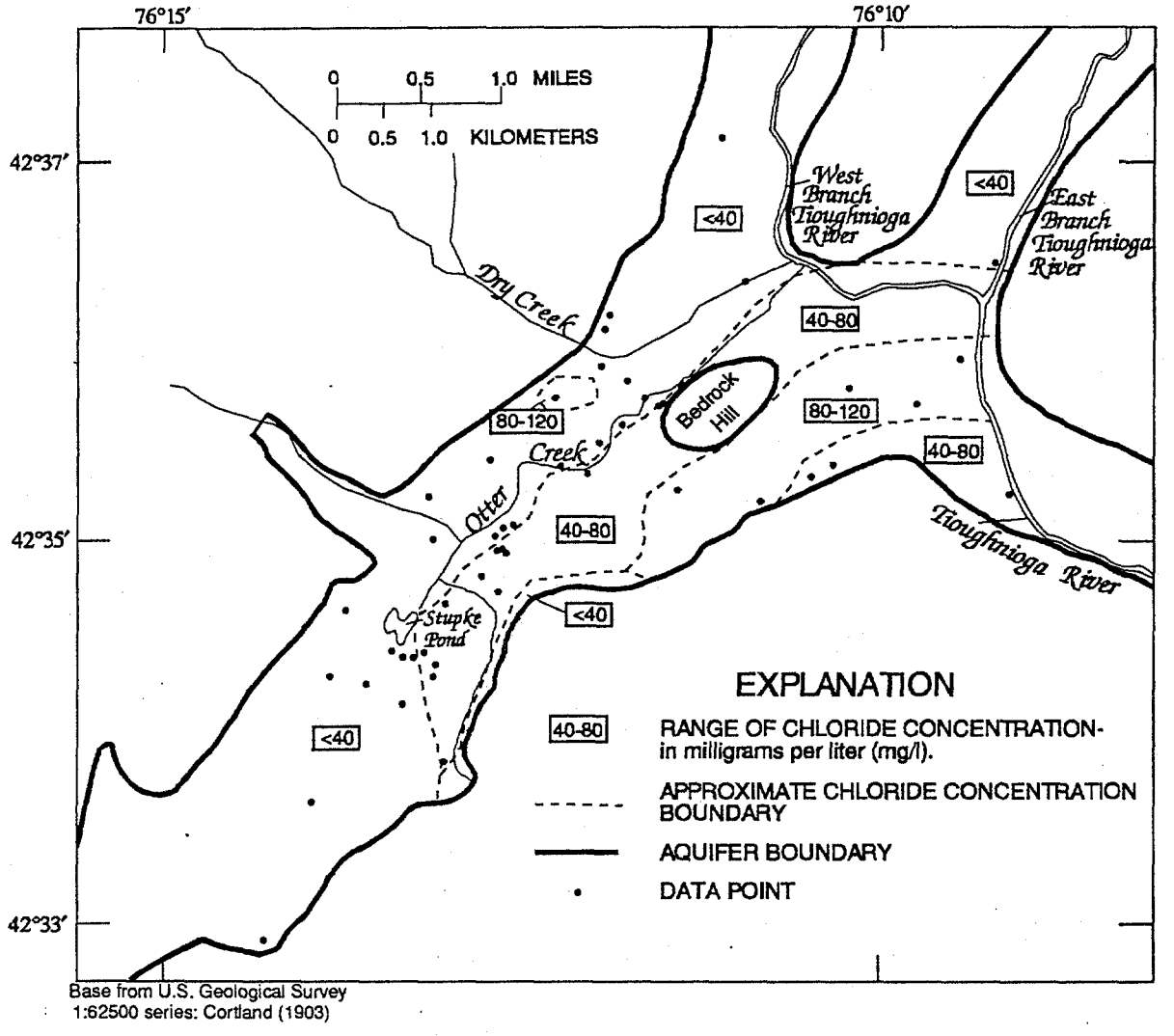

Figure 28.-- Distribution of dissolved chloride concentration in the unconfined portion of the Otter Creek-Dry Creek aquifer, April 1990.

and bacteria, human and animal wastes, and organic and inorganic fertilizers.

Samples collected in April 1990 were analyzed by the University of New York at Cortland Chemistry Department for nitrate (NO_3 total as N). Nitrate concentrations ranged from 0.1 mg/L to 12.0 mg/L, with a median concentration of 4.3 mg/L. The largest concentrations (12.0 mg/L and 8.6 mg/L) of nitrate were found in wells 304 and 204, respectively. These two wells are in close proximity to Otter Creek and just downgradient and downstream of a large dairy farm. Samples collected in September 1990 were analyzed for nitrite plus nitrate (NO_2+NO_3) dissolved as N. Nitrate (NO_3) is usually the most common nitrogen species in surface water and ground water, while nitrite (NO_2) generally occurs in concentrations of less than 0.1 mg/L and, because it is unstable, usually undergoes nitrification or denitrification (Behnke, 1974). Concentrations of NO_2+NO_3 ranged from 0.1 mg/L to 9.9 mg/L with a median concentration of 4.6 mg/L. The greatest NO_2+NO_3 concentrations were 9.9 mg/L and 8.3 mg/L found in well 5 and well 207, respectively, both of which are subject to agricultural influences. Wells 304 and 204, which had the highest concentrations in April 1990 had concentrations of 4.0 mg/L and 4.6 mg/L, respectively, in September 1990. Data from several well pairs (a shallow well and a deep well) indicate that the vertical distribution of nitrogen is fairly uniform throughout the upper portion of the unconfined aquifer. Nitrate concentration data from six wells that penetrate the clay layer in the northern part of the aquifer indicate that nitrogen is present in the confined aquifer as well, but in lower concentrations (median concentration 2.0 mg/L).

Temporal Changes

To discern any changes in water quality of the Cortland county glacial aquifer system, data collected for this study (April and September 1990) were compared to data collected in 1978 (Buller) and data collected by Cortland County personnel from November 1979 to January 1981. Only chemical data that was collected from the same wells was compared. Constituents that were compared were alkalinity, nitrite plus nitrate (NO_2+NO_3) as N, calcium, and chloride. Except for chloride, not all constituents were available for all time periods. Maximum, minimum, mean, median, and interquartile

Table 10. Minimum, maximum, mean, median, and interquartile range of concentration or value for selected constituents or properties of ground-water in the study area, grouped by year.

[Values qre in milligrams per liter unless otherwise noted, mS/cm; microsiemens per centimeter].

Constituent or property	Year	Number of samples	Minimum	Maximum	Mean	Median	Interquartile range 25th	Interquartile range 75th
Specific conductance (µS/cm)	1976	84	235	700	451	450	405	499
	1980	0	--	--	--	--	--	--
	1990	22	236	797	474	470	334	542
	1991	6	413	631	545	556	512	584
Alkalinity (as $CaCO_3$)	1976	23	63	231	168	167	152	182
	1980	0	--	--	--	--	--	--
	1990	22	62	239	180	191	167	219
	1991	12	151	300	209	210	183	224
Nitrate (total as N)	1976	27	1.6	4.9	3.4	3.4	2.8	4.1
	1980	153	.10	5.0	2.4	2.7	1.6	3.3
	1990	0	--	--	--	--	--	--
	1991	0	--	--	--	--	--	--
Nitrite + nitrate (as N)	1976	84	.55	5.6	3.2	3.4	2.7	4.0
	1980	0	--	--	--	--	--	--
	1990	22	.80	12.0	4.6	4.6	2.4	6.1
	1991	12	3.7	9.9	6.0	5.8	4.7	7.3
Calcium	1976	19	31	80	64	63	59	76
	1980	0	--	--	--	--	--	--
	1990	22	32	97	78	80	75	87
	1991	6	61	87	76	77	72	81
Chloride	1976	85	3.0	78	24	18	12	28
	1980	153	5.0	72	24	21	14	30
	1990	22	15	108	45	36	27	61
	1991	7	29	79	46	38	30	72
Sulfate (as SO_4)	1976	18	19	26	22	21	20	24
	1980	0	--	--	--	--	--	--
	1990	0	--	--	--	--	--	--
	1991	7	19	25	23	24	23	25

ranges of the compared constituents are shown in table 8.

Nonparametric statistical tests have been used to discern differences in constituent median values among years. A 0.05 level of significance (95-percent confidence level) has been used for all tests to describe the error probability of falsely detecting differences. Simple descriptive statistics such as box plots and median and interquartile range were first used to examine the distribution of the sample population of each of the chemical constituents from the different time periods. Because water-quality data usually do not exhibit a normal distribution, the median and interquartile range provide a better measure of the sample population distribution than do the mean and the standard deviation. For this reason, a Kruskal-Wallis one-way ANOVA (analysis of variance) has been performed on ranked data to compare the distribution of chemical constituents by year (Conover and Iwan, 1981). Differences among sample populations by year indicated by the Kruskal-Wallis test have been further defined by Tukey's multiple comparison test.

Concentrations of chloride, the only constituent data available for all four time periods, were significantly greater during April and September of 1990 than in 1976 or 1980. Median values for April and September 1990 were similar (36 and 38 mg/L respectivly), with the median concentration for 1980 slightly greater than for 1976 (18 and 21 respectivly). The increase in chloride concentration over the years (figure 27) is due primarily to increased use of road salt and, to a lesser extent, leakage from aging septic systems.

Median concentrations of alkalinity were greater in September of 1990 (210 mg/L) than they were in April 1990 (191 mg/L), with September concentrations significantly greater than those in 1976 (167 mg/L). Concentrations of calcium, while nearly the same for April and September 1990 (80 and 77 mg/L respectivly), but were significantly higher than in 1976 (63 mg/L). Concentrations of NO_2+NO_3 were significantly different for each sampling period; September 1990 having the highest concentrations and 1976 the lowest. The trend of increasing nitrogen concentrations may result from increased application of fertilizer to agricultural areas and lawn fertilizer to residential areas as well as leaking septic systems. The significant difference in concentrations of NO_2+NO_3 between April and September 1990 may result from two factors; (1) April samples were collected when ground-water levels were

fairly high, thus concentrations of NO_2+NO_3 may have been diluted. (2) greater concentrations during the September collection could result from lower (average of 7.4 ft) ground-water levels and nitrogen from the application of fertilizer over late spring and summer reaching the water table. Boxplots illustrating the distribution of the analytical data for alkalinity, NO_2+NO_3, calcium, and chloride for each sampling period are shown in figure 29.

FIGURE 29 NEAR HERE

Ground-Water Chemistry and Land Use

Based on the data available, only very general comparisons could be made between ground-water quality and land use. Because land use in the study area is so homogeneous, it is impossible to isolate the effects of a particular land use on the water quality of a particular well or group of wells. Most of the wells sampled (52) were in the Cortland municipal area. This municipal area is comprised of a number of smaller land- use categories including residential, industrial, commercial, recreation, major transportation routes, and other smaller land-use categories associated with urban areas. The remaining 16 wells were grouped into an agricultural land-use category. Water in these wells, which were located in the southern end and on the edges of the study area, could be more easily identified as being affected primarily by land-use activities associated with agriculture. Thus, ground-water quality was compared simply between two very broad categories of land uses. Six wells that penetrated the confined aquifer were eliminated from the data set prior to the analysis of the data because their recharge area was outside the study area.

Distributions of the chemical data for the two land-use groups were compared using boxplots (fig. 30). Any statistically significant differences in concentrations of selected chemical constituents between land uses were tested using the Kruskal-Wallis one-way ANOVA, which compares the distribution of ranks of concentrations between groups of data to determine if any of the groups are signif-

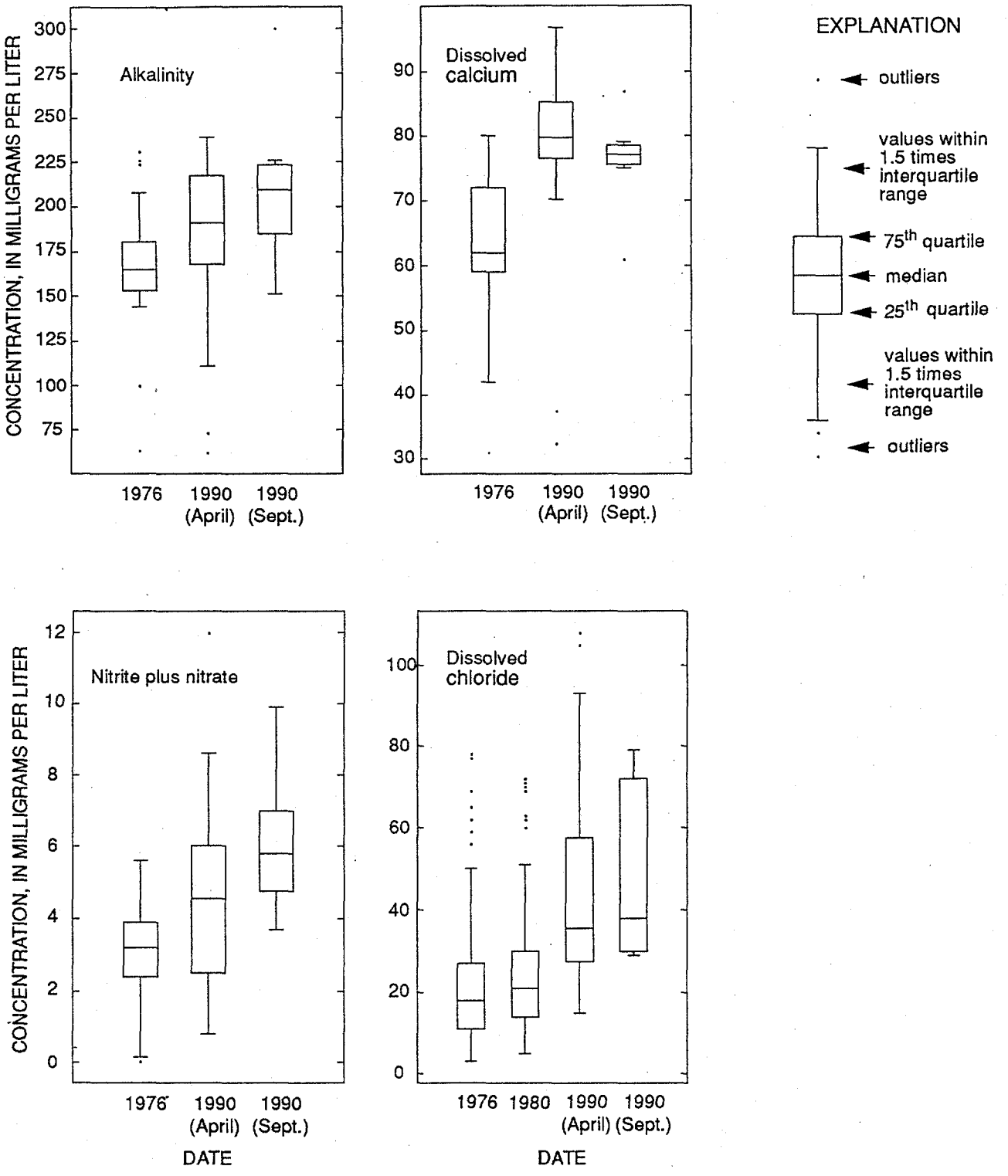

Figure 29.--Comparison by year of the distribution of concentration of four selected chemical constituents in groundwater from wells in Cortland County.

icantly different from the others. Significance was chosen at 0.05 (95-percent confidence level).

FIGURE 30 NEAR HERE

Only two constituents, specific conductance and chloride, exhibited a significant difference between the two land-use categories. Both were significantly higher in ground water from the urbanized or municipal land-use area. The higher chloride concentrations in the municipal area may be attributed to sources of chloride that are associated with urbanized land use such as road salting, industrial wastes and leakage from aging septic and sewer systems. The significantly greater specific conductance values are associated with the high chloride concentrations. Median chloride concentration was 44.5 mg/L in the municipal area and 30.0 mg/L in the agricultural area. Median values of specific conductance were 610 µS/cm and 516 µS/cm, respectively. As might be expected, median concentrations of sodium were considerably larger (although not statistically significant) in the municipal land-use area than the agricultural area at 24.0 mg/L and 15.5 mg/L, respectively. Alkalinity was slightly higher in the municipal land-use area, while median concentrations of nitrate and calcium were nearly the same. While not significantly different, concentrations of NO_2+NO_3 were considerably higher in the agricultural land-use area, reflecting the agricultural sources of that constituent. Maximum, minimum, median, mean, and interquartile ranges of the selected constituents grouped by the two land-use categories is shown in table 11.

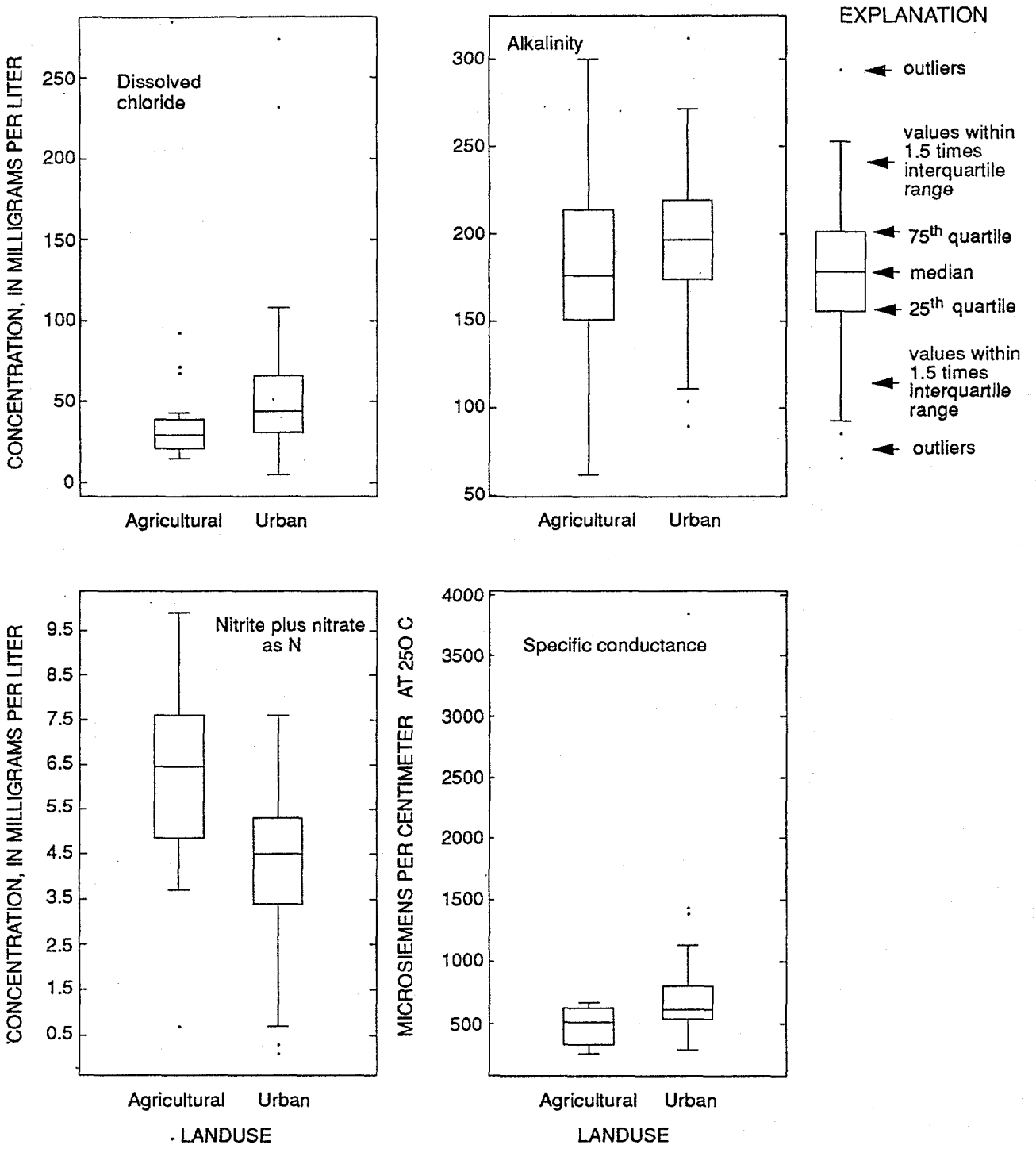

Figure 30.-- Comparison of the distribution by landuse of concentration of four selected chemical constituents or physical characteristics in ground-water from wells in Cortland County.

Table 11. Minimum, maximum, mean, median, and interquartile range of concentration or value for selected constituents or properties of ground-water in the study area, grouped by land use.

[Values qre in milligrams per liter unless otherwise noted, mS/cm; microsiemens per centimeter, *; indicates significant difference at the 95-percent confidence level in constituent concentration between land uses].

Constituent or property	Land use	Number of observations	Minimum	Maximum	Mean	Median	Interquartile range 25th	Interquartile range 75th
Alkalinity (as $CaCO_3$)	Agriculture	20	62	300	183	180	154	218
	Urban	76	90	312	197	197	177	221
*Specific conductance (µS/cm)	Agriculture	12	257	668	501	516	351	634
	Urban	43	344	3,850	728	610	546	802
Nitrate (as N)	Agriculture	12	.1	8	4.2	4.2	2.3	6.0
	Urban	45	.1	12	4.2	4.5	2.7	5.5
*Chloride (as Cl)	Agriculture	17	15	93	37	30	21	42
	Urban	50	5	274	58	44	31	67
Sodium (as Na)	Agriculture	14	4.8	51	21	16	11	30
	Urban	70	4.8	530	39	24	16	39
Calcium (as Ca)	Agriculture	14	.10	780	151	78	55	88
	Urban	70	47	241	86	79	73	89
Nitrite + nitrate (as N)	Agriculture	6	.70	9.9	5.9	6.4	3.0	8.7
	Urban	31	.30	7.6	4.3	4.6	3.5	5.4

Deleted from Appendix

APPENDIX 1: Records of wells in the Cortland aquifer system.

USGS well number	Local identification	Latitude ° ' "	Longitude ° ' "	Owner	Date drilled (mo d yr)	Altitude of land surface (ft)	Well depth (ft)	Depth to bedrock (ft)	Altitude of top of casing (ft)	Water level below land surface: Feet	Water level below land surface: Date	Reported yield (gal/min)	Remarks (vf = very fine, f = fine, m = medium, c = coarse. Numbers refer to depths below land surface.)
3	TH 3	423548	0761155	City of Cortland	08-16-79	1,136	55	--	1,137.67	11.95	08-16-79	75	Test well. 0-25 f sand, 25-45 gravel, 45-58 sand and gravel, 58-67 ft silty sand and clay.
4	CP 4	423454	0761242	T. of Cortlandville	12-29-75	1,173	63	--	1,173.45	19.50	12-29-75	--	Test well.
5	CP 5	423507	0761309	T. of Cortlandville	03-04-76	1,172	40	--	1,172.64	6.55	03-04-76	--	Well abandoned.
6	TH 6	423545	0761152	City of Cortland	08-29-79	1,136	55	--	1,137.24	11.60	08-29-79	75	Test well.
8	CP 8	423526	0761131	Leonard Barker	1974	1,146	20	--	1,146.2	12.97	02-27-76	--	Test well.
9	CP 9	423527	0761132	Leonard Barker	1976	1,146	20	--	1,146.2	12.13	02-27-76	--	Test well.
10	CP 10	423535	0761140	Curtis	1974	1,149	20	106	1,148.6	14.06	02-27-76	--	--
11	CT 11	423518	0761141	Cortland County	12-04-75	1,154	60	--	1,156.5	20.90	12-15-75	--	0-15 clay and sand, 15-50 peb sand, 50-55 sand and gravel, 55-60 gravelly sand, 60-65 claycy sand, 65-75 silty gravel, 75-85 sand and gravel, 85-100 peb f-c sand, 100-104 ft gray clay.
13	CP 13	423650	0761140	Cortland County	11-01-73	1,116	25	--	1,116.6	7.80	11-01-73	--	Test well.
15	CP 15	423704	0761108	Cortland County	02-27-76	1,114	--	--	1,114.3	5.57	02-27-76	--	Test well.
20	CT 20	423414	0761428	Cortland County	09-10-76	1,247	160	124	1,247.11	68.20	09-10-76	--	0-11 sand and gravel, 11-16 clay with some gravel, 16-48 sand and gravel, 48-64 clay with some embedded gravel (till?), 64-65 silt and f sand, 65-72 sand and gravel, 72-85 clay with some gravel, 85-87 sand and gravel, 97-89 clay, 89-94 sand and gravel, 94-97 silty clay with some gravel, 97-118 clay, 118-124 clay with some shale pebbles (till), 124-160 ft shale.
22	CT 22	423429	0761317	Cortland County	09-15-76	1,186	45	--	1,186.38	22.91	09-15-76	--	0-45 ft sand and gravel.
23	CT 23	423346	0761332	Cortland County	09-20-76	1,228	85	--	--	58.30	09-20-76	--	Well destroyed. 0-13 sand and gravel, 13-28 silt with some gravel, 28-85 ft silty sand and gravel.
24	CT 24	423314	0761415	Cortland County	09-28-76	1,270	105	--	--	--	--	--	Well destroyed. 0-100 dirty ground, 100-105 ft clay. No water encountered during drilling.

APPENDIX 1: Records of wells in the Cortland aquifer system.

USGS well number	Local identification	Latitude ° ' "	Longitude ° ' "	Owner	Date drilled (mo d yr)	Altitude of land surface (ft)	Well depth (ft)	Depth to bedrock (ft)	Altitude of top of casing (ft)	Water level below land surface: Feet	Water level below land surface: Date	Reported yield (gal/min)	Remarks (vf = very fine, f = fine, m = medium, c = coarse. Numbers refer to depths below land surface.)
33	CP 1	423323	0761403	Monarch Tool Corp.	11-10-75	1,259	209	207	--	58.27	11-10-75	25	0-83 sand and gravel, 83-130 clay and gravel, 130-178 sand and gravel, 178-183 f sand, 183-187 f sand and gravel, 187-207 sand and gravel, 207-209 ft shale.
39	CT 1D	423558	0761215	Cortland County	09-29-75	1,155	143	--	1,154.96	17.57	11-24-75	--	--
40	CT 1S	423558	0761215	Cortland County	09-29-75	1,155	44	--	1,155.39	15.06	11-24-75	--	--
47	CT 2D	423548	0761153	Cortland County	10-01-75	1,138	49	--	1,137.38	7.55	10-07-75	--	0-58 sand and gravel, 58-70 ft f sand and clay.
48	CT 2S	423548	0761153	Cortland County	10-01-75	1,138	25	--	1,137.03	7.15	11-24-75	--	0-25 ft sand and gravel.
102	C-102	423541	0761147	City of Cortland	--	1,137	45	--	1,138.59	7.68	08-30-76	--	USGS water-level observation well.
105	CT 5D	423447	0761306	Gutchess Lumber	10-09-75	1,170	59	--	1,170.89	10.62	12-01-75	--	0-15 sand and gravel, 15-20 clay and gravel (till?), 20-35 sand and gravel, 35-50 sand, 50-65 sand and gravel, 65-75 sandy clay and gravel, 75-80 sand and gravel, 80-82 f sand, 82 ft clay.
106	CP 6	423522	0761315	Cortland County Airport	1970	1,198	75	--	1,198.43	34.50	02-26-76	--	--
107	CP 7	423528	0761138	Barker, Leonard	1974	1,147	20	--	1,147.0	11.82	02-27-76	--	Test well.
108	CT 8	423251	0761423	Cortland County	10-30-75	1,299	38	--	1,300.77	7.62	12-03-76	--	0-25 clay hardpan, 25-37 f sandy clayey gravel (no water), 37-40 sand and gravel, 40-67 f sand and gravel, 67-92 silty clay, 92-95 ft sand and gravel.
110	CT 10D	423422	0761409	Cortland County	11-28-75	1,202	99	116	1,201.95	42.16	10-08-91	--	0-20 clayey sand and gravel, 20-25 sand and pebbles, 25-30 f-m sand, 30-65 clayey silty sand and gravel (till?), 65-70 f-m sand, 70-100 sand and gravel, 100-106 till, 106 ft shale.
112	CT 12D	423518	0761141	Cortland County	12-18-75	1,152	60	--	--	21.30	01-06-76	--	Well destroyed. 0-65 sand and gravel, 65-75 silty sand and gravel, 75-90 sand and gravel, 90-100 pebbly clayey sand, 100-105 sand and gravel, 105-110 silty sand and, 110-115 ft sand.and gravel.
113	CT 13	423518	0761141	Cortland County	12-15-75	1,152	63	--	--	18.26	02-04-76	--	Well destroyed.
114	CP-14	423700	0761130	Cortland County	11-01-73	1,120	25	--	1,120.3	10.80	11-01-73	--	--
119	C 19	423539	0761148	City of Cortland	--	1,140	13	--	--	5.97	07-01-67	--	Well destroyed 5-7-76 and replaced by well C-102.

APPENDIX 1: Records of wells in the Cortland aquifer system.

USGS well number	Local identification	Latitude ° ' "	Longitude ° ' "	Owner	Date drilled (mo d yr)	Altitude of land surface (ft)	Well depth (ft)	Depth to bedrock (ft)	Altitude of top of casing (ft)	Water level below land surface: Feet	Water level below land surface: Date	Reported yield (gal/min)	Remarks (vf = very fine, f = fine, m = medium, c = coarse. Numbers refer to depths below land surface.)
121	CT 21	423440	0761325	Cortland County	09-13-76	1,166	32	--	1,167.38	5.74	09-13-76	--	0-32 ft sand and gravel.
135	--	423305	0761438	Griswold, S.	10-01-65	1,277	254	254	--	96	10-01-65	8	--
138	Well I	423318	0761509	Tunison Fish Hatchery	10-18-62	1,120	52	--	--	6	10-18-62	154	0-43 clay, 43-52 sand and gravel, 52 ft clay.
139	Well R	423318	0761514	Tunison Fish Hatchery	--	1,130	60	--	--	26	09-17-92	--	--
140	Well S	423318	0761516	Tunison Fish Hatchery	10-21-80	1,130	69	--	--	23	11-06-80	100	0-41 clay and gravel, 41-51 sand and gravel, 51-69 sand and gravel, 69-70 ft clay and gravel.
142	Well A	423319	0761459	Tunison Fish Hatchery	05-22-62	1,120	56	--	--	--	--	7	0-6 gravel, 6-16 clay and gravel, 16-20 sandy clay, 20-21 sand and gravel, 21-28 clay, 28-35 f sand, clay and gravel, 35-56 ft sand and gravel.
143	Well 1	423320	0761459	Tunison Fish Hatchery	05-11-59	1,120	185	--	--	+3.5	05-11-59	--	Well abandoned. 0-35 silt, 35-50 f-m sand and silt, 50-70 f-c sand and some gravel, 70-100 f sand and silt, 100-104 sand and gravel, 104-166 clay, 166-187 f-c sand, 187-200 ft f sand and silt. Pumped 42 gal/min with 7-ft drawdown.
144	Well II	423320	0761509	Tunison Fish Hatchery	10-18-62	1,115	52	181	--	7.5	10-18-72	180	0-12 clay, 12-43 clay and sand, 44-52 sand and gravel, 52-78 clay, 78-108 clay with some gravel (till?), 108-110 clay and gravel, 110-139 clay, 139-142 sand and gravel, 142-181 clay, 181-185 ft shale.
149	Well F	423327	0761457	Tunison Fish Hatchery	1962	1,140	137	--	--	flowing	09-14-62	74	0-20 clay and gravel, 20-30 c sand, 30-41 clay and gravel, 41-44 gravel, 44-55 clay and gravel, 55-60 sand and gravel, 60-67 sand, 67-76 gravel, 76-137 ft clay and gravel.
150	Well C	423320	0761517	Tunison Fish Hatchery	1963	1,110	124	--	--	flowing	07-31-62	--	0-5 clay and gravel, 5-30 clay, 30-45 sand, 45-56 sand and gravel, 56-76 gravel with clay, 76-97 sand and gravel, 97-102 clayey gravel, 102-124 ft gravel.
151	Well E	423327	0761458	Tunison Fish Hatchery	1962	1,140	134	--	--	flowing	09-06-62	500	0-30 clay and gravel, 30-32 gravel, 32-52 clay and gravel, 52-62 sand and gravel, 62-66 sand, 66-71 clay and gravel, 75-84 sand and gravel, 84-109 clay and gravel, 109-113 sand and gravel, 113-133 clay and gravel, 133-134 gravel, 134-140 ft clay and gravel. Screen silted up and well was abandoned.
152	--	423329	0761355	Monarch Tool	1966	1,255	79	--	--	--	--	45	--
155	--	423333	0761343	Moser H. F.	1965	1,240	60	--	--	31.8	08-02-67	37	--

APPENDIX 1: Records of wells in the Cortland aquifer system.

USGS well number	Local identification	Latitude ° ' "	Longitude ° ' "	Owner	Date drilled (mo d yr)	Altitude of land surface (ft)	Well depth (ft)	Depth to bedrock (ft)	Altitude of top of casing (ft)	Water level below land surface		Reported yield (gal/min)	Remarks (vf = very fine, f = fine, m = medium, c = coarse. Numbers refer to depths below land surface.)
										Feet	Date		
163	--	423428	0761452	Armstrong, Roger	1976	1,290	155	30	--	50	1976	4	0-15 gravel, 15-30 till, 30-155 ft bedrock.
167	--	423516	0761152	Abdalah Creamery	1945	1,155	69	--	--	--	--	40	--
168	--	423520	0761115	Lehigh Railroad	1932	1,136	28	--	--	3	--	75	--
170	--	423528	0761130	Mobil Oil	1974	1,147	24	--	--	16.70	07-25-75	--	--
171	--	423533	0760824	Polkville Agway	--	1,096	34	--	--	8	--	35	0-37 ft sand and gravel.
172	PW-4	423542	0761154	City of Cortland	03-01-57	1,138	68	--	--	5	03-01-57	4,500	Public water-supply well. 0-68 sand and gravel, 68-77 ft sand and clay.
173	--	423548	0761015	Brewer Tichener	1944	1,115	155	--	--	8	--	75	--
174	--	423549	0761143	City of Cortland	1917	1,138	16	--	--	9	08-01-65	4,000	Dug well. Former public water-supply well. Currently used for water-level observation well by city of Cortland.
176	--	423602	0761019	Rubbermaid	1923	1,110	185	--	--	3	--	22	Formerly owned by Brockway Motors. 0-35 sand and gravel, 35-130 clay, 130-185 ft sand and gravel.
177	Well 1	423604	0761039	Cortland County	07-09-79	1,117	101	--	1,111.88	15.50	08-16-79	70	0-55 sand and gravel, 55-85 clay, 85-102 ft sand and gravel.
178	--	423606	0761233	Ames, Bob	07-24-77	1,180	158	75	--	34	07-24-77	10	0-5 gravel, 5-15 till, 15-158 ft bedrock.
179	--	423610	0761209	Murray Center	1943	1,150	65	--	--	20.0	04-23-87	150	--
180	--	423610	0761209	Murray Center	1943	1,150	125	75	--	--	--	60	0-75 sand and gravel, 75-125 ft shale.
181	--	423619	0760946	Brewer Tichener	1962	1,105	47	--	--	15.6	02-18-72	310	--
183	--	423631	0761115	Cortland Hospital	05-01-60	1,121	44	--	1,120.84	11	05-01-60	250	--
184	--	423638	0761006	Cortland Ready Mix	08-01-63	1,100	49	--	--	16	08-01-63	100	--
186	--	423657	0761107	Gates, Al	05-01-66	1,115	45	--	--	14	05-01-66	35	--
187	--	423709	0761119	Briggs, Lynn	02-22-66	1,120	195	188	--	--	--	30	0-20 sand and gravel, 20-75 sand and clay, 75-177 clay, 177-188 sand and gravel, 188-195 ft shale.
188	--	423710	0761127	Shultz, Al	1966	1,125	156	148	--	10	--	40	--
203	CP 3	423451	0761244	T. of Cortlandville	02-27-76	1,183	70	--	1,183.44	19.08	02-27-76	--	Test well.
204	CT 4D	423522	0761239	Cortland County	10-07-75	1,149	46.5	--	1,152.15	5.21	10-10-75	--	0-60 sand and gravel, 60-70 pebbly sand, 70-75 ft clay.

APPENDIX 1: Records of wells in the Cortland aquifer system.

USGS well number	Local identification	Latitude ° ' "	Longitude ° ' "	Owner	Date drilled (mo d yr)	Altitude of land surface (ft)	Well depth (ft)	Depth to bedrock (ft)	Altitude of top of casing (ft)	Water level below land surface Feet	Water level below land surface Date	Reported yield (gal/min)	Remarks (vf = very fine, f = fine, m = medium, c = coarse. Numbers refer to depths below land surface.)
205	CT 5S	423447	0761306	Cortland County	10-09-75	1,170	26	--	1,173.14	10.56	12-01-75	--	0-15 sand and gravel, 15-20 clay and gravel (till?), 20-35 ft sand and gravel.
207	CT 7D	423353	0761303	Cortland County	10-24-75	1,232	46	--	1,233.09	26.60	10-08-91	--	0-5 gravel, 5-15 clayey gravel (till?), 15-32 sand and gravel, 32-37 f sand, 37-41 m sand, 41-50 f sand and gravel, 50-54 till.
210	CT 10S	423422	0761407	Cortland County	11-28-75	1,202	42	116	1,201.75	40.5	10-08-91	--	0-20 clayey sand and gravel, 20-25 sand and pebbles, 25-30 f-m sand, 30-65 clayey silty sand and gravel (till?), 65-70 f-m sand, 70-100 sand and gravel, 100-106 till, 106 ft shale.
214	CT 14	423632	0761051	Cortland County	01-27-76	1,112	24	--	1,114.5	9.23	02-04-76	--	Well removed. 0-7 fill, 7-14 silt, 14-23 sand and gravel, 23-24 ft f sand.
279	ELM A	423609	0760936	Cortland County	11-09-79	1,100	29	44	1,102.63	10.4	10-08-91	--	0-5 fill, 5-30 sand and gravel, 30-37 m-c sand, 37-44 till, 44-45 ft shale.
280	ELM B	423609	0760942	Cortland County	11-15-79	1,102	34	--	1,103.87	9.4	10-08-91	--	0-45 sand and gravel, 45-50 ft f-m sand with some gravel
281	ETL A	423542	0760922	ETL	05-05-80	1,100	45	--	1,102.16	12.3	05-28-91	--	0-5 sand and gravel, 5-47 gravelly m-c sand, 47-60 ft silty clay.
282	ETL B	423542	0760917	ETL	05-09-80	1,102	50	--	1,105.06	15.6	05-28-91	--	0-15 sand and gravel, 15-52 m-c sand with some gravel, 52-57 silty clayey sand, 57-60 ft silty clay.
291	--	423327	0761458	Tunison Fish Hatchery	1962	1,140	137	--	--	--	--	74	--
303	CT 3S	423518	0761104	Cortland County	10-03-75	1,138	28	--	1,141.03	8.74	12-03-75	--	0-5 fill, 5-30 ft gravel.
304	CT 4S	423522	0761239	Cortland County	10-07-75	1,149	23	--	1,152.22	5.29	12-04-75	--	0-60 ft sand and gravel.
305	Well G	423325	0761456	Tunison Fish Hatchery	10-04-62	1,130	215	197	--	3	10-04-62	25	0-39 clay and gravel, 39-52 clayey gravel, 52-74 clay and gravel, 74-194 clay, 194-197 gravel, 197-215 ft shale.
306	CT 6D	423433	0761333	Cortland County	10-22-75	1,173	255	267	1,173.01	9.51	12-03-75	--	0-25 clayey sandy gravel, 100-105 pebbly sand, 105-130 sand and gravel, 130-150 f sand, 150-165 sand and gravel, 165-170 clayey sand with pebbles, 170-180 sand and gravel, 180-190 f sand, 190-255
307	CT 7S	423353	0761303	Cortland County	10-24-75	1,232	24	--	1,134.72	11.96	12-02-75	--	--
317	PW 3	423551	0761149	City of Cortland	03-21-49	1,137	68	--	--	2.5	03-25-49	3,200	Public water-supply well. 0-68 sand and gravel, 68-77 ft sandy clay.

APPENDIX 1: Records of wells in the Cortland aquifer system.

USGS well number	Local identification	Latitude ° ' "	Longitude ° ' "	Owner	Date drilled (mo d yr)	Altitude of land surface (ft)	Well depth (ft)	Depth to bedrock (ft)	Altitude of top of casing (ft)	Water level below land surface		Reported yield (gal/min)	Remarks (vf = very fine, f = fine, m = medium, c = coarse. Numbers refer to depths below land surface.)
										Feet	Date		
320	89-1	423350	0761351	Cortland County	11-22-89	1,196	90	--	1,198.43	28.87	12-29-89	--	0-19 sand and gravel, 19-28 pebbly sand, 28-59 sand and gravel, 59-70 sand and gravel, 70-100 ft sand and gravel.
321	--	423527	0761019	Cortland High School	01-05-87	1,200	80	--	1,201.74	72	03-28-90	--	0-80.5 ft silty sand and gravel.
322	--	423438	0761357	Park, David	06-10-81	1,215	273	103	--	--	--	2	0-18 gravel, 18-38 clay, 38-48 dirty gravel, 48-60 hardpan and sand, 60-94 clay and gravel, 94-103 till, 103-273 ft bedrock.
323	--	423244	0761419	McKee, John	10-06-88	1,320	185	75	--	--	10-06-88	7	0-20 hardpan, 20-50 gravel hardpan and clay, 50-53 gravel, 53-75 till, 75-185 ft shale.
324	--	423246	0761420	McKee, John	--	1,315	198	60	--	--	--	--	0-40 hardpan, 40-60 till, 60-198 ft shale.
325	--	423256	0761430	Ostrander, George	11-16-87	1,295	245	191	--	--	--	--	0-10 hardpan gravel, 10-70 cemented hardpan gravel, 70-120 hardpan gravel, 120-155 gravel, 160-191 clay, 191-245 ft shale.
326	90-14B	423416	0761457	USGS	07-02-90	1,240	--	38	--	--	--	--	Test boring. 0-28 coarse cobble gravel with some sand, 28-38 till with silt and clay matrix, 38-40 ft weathered shale.
327	CT 9	423230	0761440	Cortland County	11-17-75	1,242	110	304	1,242.8	63.11	12-03-75	--	0-30 clayey sand and gravel, 30-45 till, 45-130 sand and gravel, 130-300 clay, 300-304 till, 304 ft shale.
328	--	423402	0761457	Kannus	--	1,215	74	--	--	--	--	--	0-40 gravel hardpan, 40-60 sand, 60-74 fthardpan (probably a dirty gravel since the well was finished at 74 ft).
329	--	423415	0761423	Mueller	--	1,252	150	124	--	--	--	--	0-65 sand and gravel, 65-80 till, 80-100 sand and gravel, 100-124 gravel and hardpan (till? TSM), 124-150 ft shale.
330	89-2S	423548	0761230	Cortland County	11-27-89	1,147	15	--	1,148.10	7.81	12-29-89	--	0-15 ft outwash sand and gravel.
331	89-2D	423548	0761230	Cortland County	11-27-89	1,147	96	114	1,149.72	7.62	12-29-89	--	0-23 sand and gravel, 23-30 pebbly sand, 30-43 sand and gravel, 43-55 silt, 55-75 vf sand, 75-91 silt and clay, 91-114 sand and gravel, 114-116 ft gray shale.
332	90-1S	423542	0760957	Cortland County	06-12-90	1,114	34	--	1,117.25	17.3	09-27-90	--	0-34 ft sand and gravel.
333	90-1I	423526	0761228	City of Cortland	06-29-90	1,148	55	--	1,150.09	12.78	09-27-90	--	0-83.5 sand and gravel, 83.5-84 ft silt and clay.
334	90-1D	423542	0760957	City of Cortland	06-12-90	1,114	98	--	1,117.00	17.2	09-27-90	--	0-64 sand and gravel, 64-107 ft varved silt and clay.

APPENDIX 1: Records of wells in the Cortland aquifer system.

USGS well number	Local identification	Latitude ° ' "	Longitude ° ' "	Owner	Date drilled (mo d yr)	Altitude of land surface (ft)	Well depth (ft)	Depth to bedrock (ft)	Altitude of top of casing (ft)	Water level below land surface: Feet	Water level below land surface: Date	Reported yield (gal/min)	Remarks (vf = very fine, f = fine, m = medium, c = coarse. Numbers refer to depths below land surface.)
335	90-2	423603	0760946	City of Cortland	06-13-90	1,102	34	66	1,102.03	8.40	09-27-90	--	0-46 sand and gravel, 46-50 f. sand and silt, 50-56 varved silt and clay, 56-66.5 till, bedrock at 66.5 ft.
336	90-10	423524	0761219	City of Cortland	06-28-90	1,158	37	--	1,160.33	23	09-27-90	--	0-39 ft sand and gravel.
337	90-9S	423531	0761207	City of Cortland	06-28-90	1,138	42	--	1,140.41	8.22	09-27-90	--	0-44 ft sand and gravel.
338	90-9D	423531	0761207	City of Cortland	07-17-90	1,138	217	220	1,141.29	9.7	09-27-90	--	0-52 sand and gravel, 52-203 silt and clay, 203-219 sand and gravel, 219-220 till, 220-222 ft shale.
339	90-3	423623	0761116	City of Cortland	06-14-90	1,118	35	--	1,118.15	9.46	09-27-90	--	0-67 sand and gravel, 67-100 ft varved silt and clay.
340	90-6S	423457	0761305	Cortland County SPCA	06-26-90	1,165	35	--	1,166.28	13.70	09-27-90	--	0-4 silty gravel, 4-12 till, 12-18 sand and gravel, 18-34 m-very coarse sand, 34-35 ft sand and gravel
341	90-6D	423457	0761305	Cortland County SPCA	07-19-90	1,164	137	--	1,168.14	17.2	09-27-90	--	0-5 topsoil, 5-12 till, 12-37 sand and gravel, 37-60 m-c sand, 60-83 vf sand and gravel lenses, 83-108 silt and vf sand, 108-137 ft sand and gravel.
342	90-5	423517	0761157	Cortland County	06-21-90	1,160	52	--	1162.56	28.8	09-27-90	--	0-50 sand and gravel, 50-75 vc sand and fine gravel, 75-82 ft sand and gravel.
343	90-7	423440	0761336	Stupke	06-27-90	1,169	24	--	1,171.35	12.3	09-19-90	--	0-25 sand and gravel, 25-30 ft till.
344	90-13	423446	0761239	Cortland County	07-02-90	1,185	31	31	1,187.57	26.6	09-27-90	--	0-7 topsoil and debris, 7-12 silt and gravel, 12-31 silt and gravel, 31 ft gray shale.
345	90-4B	423441	0761309	USGS	06-19-90	1,185	93	--	--	17.9	06-19-90	--	Test boring. 0-18 cobbles, 18-44 till, 41-86 sand and gravel, 86-93 ft fine sand and silt.
346	Kellogg	423528	0760921	Cortland County	07-09-80	1,096	24	--	1,095.94	5.52	09-27-90	--	0-10 clay soil, 10-15 silty gravel, 15-25 sand and gravel, sand with some clay, 35-43 m-c sand with some clay, 43-99 ft varved silt and clay.
347	SPCA	423457	0761303	Cortland County SPCA	--	1,168	--	--	1,167.68	--	--	--	Dug well.
348	MW-1	423352	0761400	Gunzenhauser, Joe	07-24-87	1,235	73	--	1,237.37	70.25	09-27-90	--	0-45 sand and gravel, 45-50 fine-coarse sand with some silt, 50-76 ft sand and gravel.
349	MW-2	423413	0761340	Gunzenhauser, Joe	07-29-87	1,223	65	--	1,225.64	61.56	09-27-90	--	0-66 ft sand and gravel.
350	--	423430	0761319	Danglier	--	1,185	57	--	--	--	--	30	--
351	--	423429	0761319	Pace	05-12-62	1,185	55	--	--	--	--	30	--

APPENDIX 1: Records of wells in the Cortland aquifer system.

USGS well number	Local identification	Latitude ° ' "	Longitude ° ' "	Owner	Date drilled (mo d yr)	Altitude of land surface (ft)	Well depth (ft)	Depth to bedrock (ft)	Altitude of top of casing (ft)	Water level below land surface		Reported yield (gal/min)	Remarks (vf = very fine, f = fine, m = medium, c = coarse. Numbers refer to depths below land surface.)
										Feet	Date		
352	--	423430	0761315	Fitts	--	1,185	--	--	--	--	--	--	--
353	--	423450	0761251	Pauldine	--	1,155	--	--	--	--	--	--	--
354	T-103	423452	0761240	T. of Cortlandville	01-13-59	1,184	72	--	--	27	01-13-59	440	0-20 clayey sand and gravel, 20-36 clayey sand., 36-37 gravel, 37-45 c.sand, 45-55 gravel and clay, 55-72 sand and gravel, 72-76 ft gravel and clay.
355	T-103	423454	0761240	T. of Cortlandville	08-21-75	1,177	63	--	--	29.7	09-11-75	660	0-30 sand and boulders, 30-63 c.sand. and gravel, 63-65 sand and gravel with clay, 65-70 ft gravel hardpan.
356	MW-3D	423528	0761205	City of Cortland	12-11-86	1,143	58	--	1,145.03	4.52	03-28-90	--	0-60 silty sand and gravel, 60.5-61 ft silt.
357	MW-1	423538	0761204	City of Cortland	12-11-86	1,141	48	--	1,142.84	5.34	03-28-90	--	0-48 ft sand and gravel.
358	MW-2	423528	0761223	City of Cortland	12-16-86	1,143	36	--	1,144.99	1.96	03-28-90	--	0-47 ft sand and gravel.
359	Dowzer 1	423523	0761047	Dowzer Corp.	--	1,140	23	--	1,142.3	10.8	05-25-90	--	--
360	Dowzer 2	423524	0761042	Dowzer Corp.	--	1,136	23	--	1,138.9	7.3	05-25-90	--	0-3 fill, 3-7 silt and clay, 7-23 ft f-c sand with some gravel.
361	MW-3S	423527	0761206	City of Cortland	12-18-86	1,142	25	--	1,143.81	5.3	03-28-90	--	0-45 ft sand and gravel.
362	--	423507	0761251	Pall Trinity Corp.	12-20-86	1,167	67	--	1,169.00	--	--	--	0-67 sand and gravel, 67 ft f sand. Screened intervals 60-67 ft.
363	Well 1	423502	0761249	Pall Trinity Corp.	12-15-83	1,165	63	--	1,167.69	12	12-15-83	170	0-20 gravel, 20-32 silty gravel, 32-63 ft gravel.
364	Substa	423501	0761253	Pall Trinity Corp.	--	1,168	35	--	1,169.68	12.7	03-13-91	--	--
365	Hess 1	423554	0761003	--	1982	1,130	13	--	1,107.47	9.5	03-28-90	--	--
366	--	423554	0761032	--	--	1,135	--	--	--	--	--	--	--
367	--	423432	0761327	Stupke	--	1,173	--	--	--	--	--	--	--
368	Ames	423458	0761245	--	1986	1,168	24	--	1,170.31	20.3	09-19-89	--	Test well for gasoline spill.
369	--	423551	0761235	Turner Veterinarian	--	1,163	55	--	1,167.67	22.17	03-28-90	--	0-55 ft sand and gravel.
370	MW-4	423613	0761207	Murray Center	02-25-87	1,154	42	42	1,156.64	25.5	02-25-87	--	0-42 sand and gravel, 42 ft shale.
371	--	423602	0761225	Wright	--	1,170	65	25	--	--	--	--	0-25 gravel hardpan, 25-65 ft shale.

APPENDIX 1: Records of wells in the Cortland aquifer system.

USGS well number	Local identification	Latitude ° ' "	Longitude ° ' "	Owner	Date drilled (mo d yr)	Altitude of land surface (ft)	Well depth (ft)	Depth to bedrock (ft)	Altitude of top of casing (ft)	Water level below land surface: Feet	Water level below land surface: Date	Reported yield (gal/min)	Remarks (vf = very fine, f = fine, m = medium, c = coarse. Numbers refer to depths below land surface.)
372	--	423617	0761254	Hart	--	1,220	195	108	--	--	--	--	0-25 gravel hardpan, 25-38 c. gravel, 38-68 gravel hardpan, 68-108 gray hardpan,till?, 108-195 ft gray shale.
373	--	423632	0761116	Cortland Hospital	09-07-78	1,121	42	--	1,120.84	10.27	03-28-90	556	0-42 ft sand and gravel.
375	--	423434	0761433	Petrella	--	1,260	115	15	--	--	--	--	0-15 sand and gravel, 15-115 ft shale.
376	--	423411	0761408	Space	--	1,230	52	--	--	--	--	--	0-30 sand and gravel, 30-49 clay and sand, 49-52 ft gravel.
377	--	423512	0761407	Miller	--	1,245	76	21	--	--	--	--	0-15 hardpan gravel, 15-21 gray hardpan gravel (till?), 21-76 ft shale.
378	NW-5D	423423	0761328	Smith Corona Corp.	12-11-86	1,176	69	--	1,179.07	13.8	12-11-86	--	0-78 sand and gravel, 78-80 ft f. sand with little silt.
379	MW-4D	423424	0761313	Smith Corona Corp.	11-21-86	1,208	102	--	1,211.01	47.3	12-03-86	--	0-102 ft sand and gravel.
380	92-1A	423426	0761319	Cortland County	09-26-92	1,192	54	--	1,194.93	27.37	10-06-92	100	0-54 ft sand and gravel.
381	92-1B	423426	0761319	Cortland County	09-26-92	1,192	212	245	1,193.40	27.6	10-06-92	--	0-106 sand and gravel, 106-110 till, 110-175 varved silt and clay, 175-216 sand and gravel, 216-220 silt and clay, 220-245 sand and gravel, 245 ft bedrock (siltstone).
382	--	423232	0761412	Jacobs	--	1,410	100	22	--	--	--	--	0-15 till, 15-22 till and weathered shale, 22-100 ft shale.
383	--	423302	0761436	Williams	09-03-87	1,290	74	--	--	--	--	10	0-16 gravel, 16-48 sand and gravel, 48-72 dry gravel, 72-75 ft gravel.
384	--	423507	0761207	Tutino	--	1,160	45	--	--	--	--	--	0-20 gravel, 20-30 gravel and sand, 30-45 ft gravel.
385	--	423343	0761453	Baker, J.	--	1,190	75	75	--	7	03-31-60	--	0-75 sand and gravel, 75 ft shale.
386	--	423537	0760912	ETL Corp.	07-29-80	1,102	40	--	--	--	--	--	0-20 sand and gravel, 20-25 m-f sand, 25-45 sand and gravel, 45-47 f-c sand, 47-56 sand and gravel, 56-106 ft silt, tr clay, vf sand.
387	--	423439	0761447	Shedd	--	1,360	205	21	--	--	--	--	0-21 till, 21-205 ft shale.
388	--	423441	0761409	Space	--	1,215	330	59	--	--	--	--	0-25 gravel, 25-30 hardpan-gravel, 30-49 clay and sand, 49-52 gravel, 52-59 ?, 59-330 ft shale.
389	91-2	423524	0761409	Cortland County	05-14-91	1,250	22	33	1,251.95	14.3	05-14-91	--	0-28 sand and gravel, 28-33 till, 33 ft shale.
390	--	423512	0761326	--	--	1,205	198	--	--	53	05-15-86	--	--

APPENDIX 1: Records of wells in the Cortland aquifer system.

USGS well number	Local identification	Latitude ° ' "	Longitude ° ' "	Owner	Date drilled (mo d yr)	Altitude of land surface (ft)	Well depth (ft)	Depth to bedrock (ft)	Altitude of top of casing (ft)	Water level below land surface Feet	Water level below land surface Date	Reported yield (gal/min)	Remarks (vf = very fine, f = fine, m = medium, c = coarse. Numbers refer to depths below land surface.)
391	--	423510	0761323	--	--	1,205	67	--	--	47	06-01-86	--	--
392	Well 2	423417	0761321	Smith Corona Corp.	12-15-74	1,212	100	--	--	42.1	12-31-74	1,060	0-7 sand and gravel, 70-100 c sand, 100-102 ft clay and gravel.
393	B-1	423520	0761302	T. of Cortlandville	07-01-86	1,158	72	--	--	8.5	07-01-86	--	Test boring. 0-71.5 ft sand and gravel.
394	--	423530	0761253	Cummins	--	1,260	32	--	--	--	--	--	0-32 ft sand and gravel.
395	--	423338	0761302	Bliss	--	1,275	44	29	--	--	--	--	0-5 Topsoil, 5-14 till, 14-28 f. sand, 28-29 sand and gravel, water bearing, 29-44 ft shale.
396	MW-3	423404	0761327	Smith Corona Corp.	1986	1,226	83	--	1,228.06	56.2	12-09-86	--	--
397	--	423520	0760840	Cortland County	07-08-80	1,094	19	--	1,097.45	9	07-08-80	--	0-25 sand and gravel, 25-28 f-m sand, 28-47 m-vc sand with gravel, 47-50 clay and gravel, 50-99 ft varved silt and clay.
398	MW-13	423421	0761320	Smith Corona Corp.	09-23-92	1,210	124	--	--	--	--	--	0-104 sand and gravel, 104-107 pebbly sand, 107-110 silty gravel or till, 110-112 silty gravel, 112-116 ?, 116-120 silt and sand, 120-124 pebbles, 125 ft till.
399	C-15	423611	0761030	Beaudry Wall Paper	--	1,110	82	--	--	--	--	275	--
400	--	423424	0761303	Walmart	--	1,201	75	--	1,202.98	35.23	05-29-91	--	Well destroyed. Former Exxon well.
401	MW-2	423427	0761256	Walmart	02-26-91	1,199	40	--	1,201.23	34.77	05-29-91	--	0-46 ft sand and gravel.
402	MW-1	423428	0761250	Walmart	02-25-91	1,199	37	--	1,201.86	28.5	02-26-91	--	0-40 ft sand and gravel.
403	CT-3D	423518	0761104	Cortland County	10-03-75	1,138	54	--	1,139.37	8.79	12-03-75	--	0-5 fill, 5-30 gravel, 30-35 silty gravel, 35-40 pebbly sand, 40-50 sand and gravel, 50-55 m-c sand, 55-60 sand and gravel, 60-70 f sand and clay.
404	MW-1	423612	0761208	Murray Center	03-09-87	1,155	34	--	1,156.18	24.9	03-09-87	--	0-34 sand and gravel, 34-37 ft silt and fine sand.
406	CT-6S	423433	0761333	Cortland County	10-22-75	1,173	26	--	1,172.82	10.54	12-03-75	--	--
407	--	423716	0760922	Yellow Lantern	04-06-72	1,105	30	--	--	5	04-26-72	--	0-10 topsoil, 10-22 sandy clay and gravel, 22-25 cemented gravel, 25-30 sand and gravel, 30 ft clay.
408	--	423726	0760925	Sun Pipe Line	04-21-69	1,140	39	--	--	20	04-21-69	--	0-10 gravel, 10-39 ft sand and gravel.
410	91-6S	423528	0761102	Cortland County	10-01-91	1,134	30	--	1,136.64	15.6	10-01-91	--	0-44 ft.sand and gravel. Watch out for kid shooting pellet gun.

APPENDIX 1: Records of wells in the Cortland aquifer system.

USGS well number	Local identification	Latitude ° ' "	Longitude ° ' "	Owner	Date drilled (mo d yr)	Altitude of land surface (ft)	Well depth (ft)	Depth to bedrock (ft)	Altitude of top of casing (ft)	Water level below land surface		Reported yield (gal/min)	Remarks (vf = very fine, f = fine, m = medium, c = coarse. Numbers refer to depths below land surface.)
										Feet	Date		
411	--	423709	0761142	--	--	1,150	61	--	--	--	--	--	Finished in sand and gravel.
412	--	423709	0761139	--	--	1,145	121	--	--	--	--	--	Finished in confined sand and gravel aquifer.
413	--	423711	0761137	Edlund	06-09-69	1,138	136	--	--	--	--	--	100-136 ft sand and gravel.
414	C-17	423536	0761024	Cobaco Baking Co.	--	1,122	103	--	--	--	--	--	0-35 sand and gravel, 35-96 silty, 96-103 ft hardpan or gravel.
415	--	423504	0761016	Wilcox	--	1,285	75	43	--	--	--	--	43-75 ft shale.
416	--	423635	0760959	--	--	1,102	112	--	--	--	--	--	Test boring. 0-54 sand and gravel, 54-93 silt, 93-108 f. sand and silt, 108-112 ft silt with some sand and gravel.
417	--	423634	0760958	--	--	1,102	112	--	--	--	--	--	Test boring. 0-53 sand and gravel, 53-83 silt, 83-97 sand, with some gravel, 97-102 sand and silt, 102-108 sand, 108-112 ft silty and sand.
418	--	423631	0760944	--	--	1,090	43	--	--	--	--	--	Test boring. 0-18 sand and gravel, 18-28 fine-coarse sand, 28-43 ft sand and gravel.
419	Yaman A	423635	0760926	Cortland County	07-10-80	1,100	24	33	1,101.22	9.84	06-28-90	--	0-10 gravel, 10-11 clay, 11-13 gravel, 13-18 c sand and fine gravel, 18-25 clayey sand and gravel, 25-27 m. sand, 27-33 till, 33 ft shale.
420	Yaman B	423636	0760929	Cortland County	07-11-80	1,105	28	--	1,106.64	8.2	05-28-91	--	0-28 ft sand and gravel.
421	Well D	423320	0761512	Tunison Fish Hatchery	08-10-62	1,110	126	--	--	-3.0	08-10-62	--	0-20 clay and gravel, 20-27 c sand, 27-29 clay and gravel, 29-32 c sand, 32-44 f sand, 44-60 clay, 60-70 clay and gravel, 70-73 gravel, 73-103 clay and gravel, 103-127 sand and gravel, 127-130 ft clay and gravel.
422	W-9	423534	0761021	Blasland & Bouck	02-20-91	1,122	73	--	1,123.57	12.0	05-10-91	--	0-3 fill, 3-17 m-c sand with some gravel, 17-32 sand and gravel, 32-42 f sand with some silt and gravel, 42-49 sand and gravel, 96-98 ft m-c sand with some gravel.
423	W-15	423534	0761029	Blasland & Bouck	12-30-91	1,123	90	--	1,125.02	13.7	02-10-92	--	0-10 fill, 10-15 sand and gravel, 15-44 f-c sand with little gravel, 44-58 sand and gravel, 58-77 f sand and silt, 77-90 ft f-c sand with some silt.
424	W-12	423533	0761035	Blasland & Bouck	02-06-91	1,126	50	--	1,127.63	13.3	05-10-91	--	0-35 m-c sand with some gravel, 35-38 sand and gravel, 38-48 m sand with some gravel, 48-60 ft f. sand.

APPENDIX 1: Records of wells in the Cortland aquifer system.

USGS well number	Local identification	Latitude ° ' "	Longitude ° ' "	Owner	Date drilled (mo d yr)	Altitude of land surface (ft)	Well depth (ft)	Depth to bedrock (ft)	Altitude of top of casing (ft)	Water level below land surface		Reported yield (gal/min)	Remarks (vf = very fine, f = fine, m = medium, c = coarse. Numbers refer to depths below land surface.)
										Feet	Date		
425	W-11	423534	0761029	Blasland & Bouck	02-04-91	1,123	52	--	1,124.47	11.7	05-22-92	--	0-16 f-c sand with some gravel, 16-30 sand and gravel, 30-50 f-c sand with little gravel, 50-56 silt and sand, 56-58 ft f sand.
426	W-14	423529	0761037	Blasland & Bouck	02-27-91	1,131	69	--	1,132.19	6.7	02-27-91	--	0-4 fill, 4-6 silt, 6-24 f-c sand with some gravel, 24-29 gravelly silt, 29-39 sand and gravel, 39-70 m-c sand with some gravel, 70-74 sand and gravel, 74-84 ft m-c sand with some gravel.
427	B-5	423531	0761026	Blasland & Bouck	01-30-91	1,126	95	--	--	8.0	01-30-91	--	0-3 fill, 3-8 gravelly silt, 8-28 m-c sand with some gravel, 28-42 sand and gravel, 42-80 m sand with some gravel, 80-88 sand and gravel, 88-95 ft till.
428	TH-1	423551	0761149	City of Cortland	08-14-79	1,132	55	100	1,134.18	2.8	03-28-90	--	0-60 sand and gravel, 60-100 silt, 100 ft bedrock.
429	91-6D	423528	0761102	Cortland County	10-01-91	1,134	198	270	1,136.99	14.25	10-01-91	--	0-44 sand and gravel, 44-58 silty vf sand, 58-65 silt and clay, 65-115 silt and vf sand, 115-150 clay and silt, 150-182 vf sand, 182-254 sand and gravel, 254-27 till, 270 ft shale.
430	91-1	423542	0760957	Cortland County	01-10-91	1,114	313	313	1,117.22	14.6	01-10-91	--	0-64 sand and gravel, 64-138 silt and clay, 138-149 sand and gravel, 149-180 sand, 180-227 sand and gravel, 227-234 silt and sand, 234-280 peb sand, 280-313 gravel, 313 ft bedrock.
431	B-2	423510	0761257	T. Cortlandville	07-08-86	1,158	96	--	--	8.5	07-08-86	--	0-80 sand and gravel, 80-85 f-m sand, 85-90 silt and sand, 90-96 ft f-m sand.
432	C-104	423351	0761352	T. Cortlandville	02-16-88	1,197	90	--	1,198.11	31	05-18-88	1,330	Public water-supply well. 0-90 ft sand and gravel.
434		423420	0761320	Smith Corona Corp.	10-20-89	1,208	92	--	--	--	--	975	Recovery well for TCE. 0-92 ft sand and gravel.
435		423424	0761404	Monarch Tool Corp.	--	1,259	87	--	--	46	08-02-67	150	Drawdown = 29 ft.
446	W2	423647	0761103	Cortland County Highway Department	05-12-86	1,114	14	--	1,115.84	6.7	05-30-91	--	Oil in well
447	28-29b	423738	0761039	N.Y.S.D.O.T.	--	1,116				--	--		0-40 sand and gravel, 40-52 silt, 52-61 till, 61-68 ft shale.
448	MW-7	423419	0761319	Smith Corona Corp.	12-09-86	1,212	57		1,213.51	47.04	06-11-87	--	0-57 ft sand and gravel
449		423432	0761332	Jebbet		1,172	--	--	--	--	--	--	

Appendix 3.--Organic chemical analyses of ground water from selected wells in the glacial-aquifer system in Cortland County, New York.

[Analyses done by the U.S. Geological Survey National Water Quality Laboratory; --, indicates no data available; <, less than; µS/cm, microsiemens per centimeter; µg/L, micrograms per liter; well locations shown in plate 1]

				Total concentration, in micrograms per liter										
Well number	Well depth (feet)	Sample date yr/m/d	Sample depth (feet)	Tetra-chloro-ethylene	Tri-chloro-ethylene	1,1,1-Tri-chloro-ethane	1,1-Di-chloro-ethylene	Benzene	Toluene	Xylene	Dichlor-bromo-methane	Methyl-chloride	1,2-Trans-dichloro-ethene	Cis-1,2-dichloro-ethene
1	--	90/04/05	--	--	--	0.25	--	--	--	--	--	--	--	--
11	81.0	90/04/05	--	<0.20	0.40	2.0	<0.20	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	--
		90/09/19	--	--	0.04	1.4	--	--	--	--	--	--	--	--
22	45.0	90/04/03	--	<0.20	11.0	0.20	<0.20	<0.2	<0.2	<0.2	<0.2	<0.2	5.9	--
		90/09/20	--	--	14.6	0.05	--	--	--	--	--	--	--	3.50
		93/04/27	--	--	6.2	--	--	--	--	--	--	--	--	--
105	59.0	90/04/05	--	--	82.8	--	--	--	--	--	--	--	--	23.8
		90/09/17	--	--	53.9	--	--	--	--	--	--	--	--	16.8
		93/04/27	--	--	54.0	0.01	--	--	--	--	--	--	--	25.0
121	32.0	90/04/04	--	--	101	--	--	--	--	--	--	--	--	34.5
		90/09/20	--	--	66.8	0.20	--	--	--	--	--	--	--	21.0
		93/04/27	--	--	75.0	0.60	--	--	--	--	--	--	--	32.0
172	77.0	90/04/05	--	--	0.02	1.2	0.10	--	--	--	--	--	--	0.20
		90/10/02	--	--	--	0.60	--	--	--	--	--	--	--	--
		90/10/15	--	--	11.4	--	--	--	--	--	--	--	--	0.60
177	92.5	90/04/06	--	0.25	--	--	--	--	0.2	--	--	--	0.3	--
204	46.5	90/04/04	--	--	2.30	0.40	--	--	--	--	--	--	--	1.10
		90/09/17	--	--	1.90	0.30	--	--	--	--	--	--	--	0.80
		93/04/27	--	--	3.4	0.60	--	--	--	--	--	--	--	2.10
205	26.0	90/04/05	--	--	7.00	--	--	--	--	--	--	--	--	1.80
		90/09/17	--	--	24.2	--	--	--	--	--	--	--	--	10.0
		93/04/27	--	--	4.80	0.06	--	--	--	--	--	--	--	1.00
280	34.0	90/04/06	--	--	--	1.6	0.20	0.4	--	--	--	--	--	0.10
		90/09/19	--	--	--	1.5	--	--	--	--	--	--	--	--
304	23.0	90/04/04	--	--	2.70	0.20	--	--	--	--	--	--	--	0.40
		90/09/17	--	--	2.60	1.0	--	--	--	--	--	--	0.2	0.50
		93/04/27	--	--	2.3	0.40	--	--	--	--	--	--	--	0.50
317	68.0	93/04/27	--	--	0.40	0.30	--	--	--	--	--	--	--	0.95
320	90.0	90/09/20	--	--	0.10	--	--	--	--	--	--	--	--	1.20
330	15.0	90/04/05	--	--	--	0.10	2.4	--	0.8	--	--	--	1.0	--
		90/04/05	--	--	--	0.10	2.4	--	0.8	--	--	--	1.0	--
332	34.0	90/09/18	--	--	15.2	107	--	--	--	--	--	--	28.9	--

Appendix 3.--Organic chemical analyses of ground water from selected wells in the glacial-aquifer system in Cortland County, New York, continued

				Total concentration, in micrograms per liter										
Well number	Well depth (feet)	Sample date yr/m/d	Sample depth (feet)	Tetra-chloro-ethylene	Tri-chloro-ethylene	1,1,1-Tri-chloro-ethane	1,1-Di-chloro-ethylene	Benzene	Toluene	Xylene	Dichlor-bromo-methane	Methyl-chloride	1,2-Trans-dichloro-ethene	Cis-1,2-dichloro-ethene
333	55.0	90/09/18	--	--	1.10	2.4	--	--	--	--	--	--	--	2.10
335	34.0	90/09/18	--	--	0.10	2.7	--	--	--	--	--	--	--	--
336	37.0	90/09/18	--	--	0.06	0.4	--	--	--	--	--	--	0.3	0.04
340	35.0	90/09/19	--	--	40.2	0.35	--	--	--	--	--	--	--	10.1
		93/04/27	--	--	21.0	0.20	--	--	--	--	--	--	--	5.40
341	137.0	90/07/19	17	0.07	15.9	--	4.0	--	--	--	--	--	--	--
		90/07/19	27	--	35.0	--	10.30	--	--	--	--	--	--	--
		90/07/19	37	--	31.3	--	6.30	--	--	--	--	--	--	--
		90/07/19	47	--	19.6	--	3.30	--	--	--	--	--	--	--
		90/07/19	57	--	13.8	--	3.10	--	--	--	--	--	--	--
		90/07/19	67	--	0.50	--	0.20	--	--	--	--	--	--	--
		90/09/19	--	--	0.04	--	--	--	--	--	--	--	--	0.04
		93/04/27	--	--	0.10	--	--	--	--	--	--	--	--	--
342	52.0	90/09/17	--	--	0.06	1.40	--	--	--	--	--	--	0.3	--
343	24.0	90/09/20	--	--	0.40	--	--	--	--	--	--	--	--	--
346	24.0	90/04/03	--	--	--	6.20	0.50	--	--	--	--	--	--	--
		90/04/06	--	--	--	11.5	1.10	1.4	0.2	--	--	--	--	--
		90/09/19	--	--	--	13.8	--	--	--	--	--	--	0.6	--
347	--	90/04/05	--	--	65.1	--	0.15	--	--	--	--	--	--	12.6
		90/09/20	--	--	30.5	0.10	--	--	--	--	--	--	--	6.90
		90/10/15	--	--	62.8	0.04	--	--	--	--	--	--	--	16.0
		90/11/24	--	--	63.2	--	--	--	--	--	--	--	--	11.3
		90/12/12	--	--	44.2	0.20	--	--	--	--	--	--	--	12.0
		93/04/27	--	--	57.0	0.50	--	--	--	--	--	--	--	20.0
		93/04/29	--	--	59.0	0.40	--	--	--	--	--	--	--	24.0
348	73.0	90/09/18	--	--	--	0.04	--	--	--	--	--	--	0.2	--
351	55.0	90/04/05	--	--	101	--	0.20	--	--	--	--	--	0.2	62.2
		90/09/20	--	--	53.0	0.20	--	--	--	--	--	--	--	35.0
		90/10/15	--	--	59.0	0.15	--	--	--	--	--	--	--	36.0
		90/11/24	--	--	62.0	--	--	--	--	--	--	--	--	33.0
		90/12/12	--	--	61.5	--	--	--	--	--	--	--	--	39.0
		93/04/27	--	--	36	0.20	--	--	--	--	--	--	--	4.80

Appendix 3.--Organic chemical analyses of ground water from selected wells in the glacial-aquifer system in Cortland County, New York, continued

Well number	Well depth (feet)	Sample date yr/m/d	Sample depth (feet)	Total concentration, in micrograms per liter										
				Tetra-chloro-ethylene	Tri-chloro-ethylene	1,1,1-Tri-chloro-ethane	1,1-Di-chloro-ethylene	Benzene	Toluene	Xylene	Dichlor-bromo-methane	Methyl-chloride	1,2-Trans-dichloro-ethene	Cis-1,2-dichloro-ethene
352	55.0	90/04/04	--	--	15.6	--	--	--	--	--	--	--	--	0.54
		90/09/20	--	--	9.50	0.05	--	--	--	--	--	--	--	0.40
352	55.0	93/04/27	--	--	12	0.06	--	--	--	--	--	--	--	0.90
353	--	90/04/05	--	--	17.2	3.20	1.10	--	--	--	--	--	--	8.50
		90/10/17	--	--	6.90	1.20	--	--	--	--	--	--	--	5.10
355	63.0	90/04/03	--	--	--	0.15	--	--	--	--	--	--	--	--
		90/09/19	--	--	0.20	--	--	--	--	--	--	--	0.3	0.40
356	57.6	90/04/05	--	--	--	6.50	0.60	--	--	--	--	--	--	0.40
		90/09/18	--	--	0.60	3.20	--	--	--	--	--	--	--	0.30
357	48.0	90/04/05	--	--	0.03	0.40	0.20	--	--	--	--	--	--	0.20
		90/09/18	--	--	0.04	0.50	--	--	--	--	--	--	--	0.03
358	35.5	90/04/05	--	--	0.95	1.50	0.20	--	--	--	--	--	--	0.22
		90/09/18	--	--	0.90	0.80	--	--	--	--	--	--	--	0.30
362	67.0	90/04/05	--	2.50	49.1	3.10	--	--	--	--	--	--	--	14.9
		90/09/20	--	3.10	43.2	6.50	--	--	--	--	--	--	--	12.50
		90/10/15	--	--	37.4	6.30	--	--	--	--	--	--	--	10.9
		90/11/26	--	1.00	38.0	2.20	--	--	--	--	--	--	--	13.9
		90/12/12	--	2.90	39.8	4.20	--	--	--	--	--	--	--	11.0
		93/04/29	--	--	36.0	2.40	--	--	--	--	--	--	--	14.0
363	63.0	90/04/05	--	--	45.9	--	--	--	--	--	--	--	--	18.2
		90/09/20	--	--	25.3	0.20	--	--	--	--	--	--	--	10.4
		90/10/15	--	--	30.6	0.50	--	--	--	--	--	--	--	11.0
		90/11/26	--	--	31.5	--	--	--	--	--	--	--	--	9.90
		90/12/12	--	--	31.3	0.60	--	--	--	--	--	--	--	11.5
364	63.0	93/04/29	--	--	26.0	0.40	--	--	--	--	--	--	--	13.0
		90/04/05	--	0.30	53.8	--	--	--	--	--	--	--	--	17.3
		90/09/20	--	--	37.3	0.20	--	--	--	--	--	--	--	15.4
		90/10/15	--	--	49.6	0.40	--	--	--	--	--	--	--	15.4
		90/11/26	--	--	45.0	--	--	--	--	--	--	--	--	12.6
		90/12/12	--	--	44.6	0.30	--	--	--	--	--	--	--	15.4

Appendix 3.--Organic chemical analyses of ground water from selected wells in the glacial-aquifer system in Cortland County, New York, continued

Well number	Well depth (feet)	Sample date yr/m/d	Sample depth (feet)	Total concentration, in micrograms per liter											
				Tetra-chloro-ethylene	Tri-chloro-ethylene	1,1,1-Tri-chloro-ethane	1,1-Di-chloro-ethylene	Benzene	Toluene	Xylene	Dichlor-bromo-methane	Methyl-chloride	1,2-Trans-dichloro-ethene	Cis-1,2-dichloro-ethene
365	14.0	90/04/03	--	--	--	0.50	0.30	0.2	4.5	2.0	--	--	--	--
		90/09/17	--	--	0.10	0.30	--	--	--	--	--	--	0.4	0.06
		90/10/17	--	--	--	--	--	2.1	42.5	5.3	--	--	--	--
366	--	90/09/20	--	0.50	0.80	0.40	--	--	--	--	--	--	--	--
367	--	90/04/04	--	--	50.3	--	--	--	--	--	--	--	--	6.90
		90/09/20	--	--	19.5	--	--	--	--	--	--	--	--	2.30
367	--	90/10/15	--	--	25.3	--	--	--	--	--	--	--	--	3.10
		90/11/24	--	--	27.4	--	--	--	--	--	--	--	--	--
		90/12/12	--	--	31.7	--	--	--	--	--	--	--	--	4.70
		93/04/28	--	--	31.0	--	--	--	--	--	--	--	--	3.90
368	24.0	90/04/03	--	--	--	--	--	--	0.4	--	--	--	--	--
		90/09/17	--	--	0.06	0.02	--	--	--	--	--	--	0.2	0.20
380	54.0	93/04/27	--	--	17.0	0.08	--	--	--	--	--	--	--	1.90
406	26.0	90/04/03	--	--	0.10	--	--	--	--	--	--	--	--	--
		93/04/27	--	--	4.80	0.06	--	--	--	--	--	--	--	10.0

Appendix 2.--Inorganic chemical analyses of ground water from selected wells in the glacial-aquifer system in Cortland County, New York, April 1990.

[Analyses done by the Chemistry Department at the State University of New York at Cortland; --, indicates no data available; <, less than; all values are in milligrams per liter unless otherwise noted; µS/cm, microsiemens per centimeter; µg/L, micrograms per liter; well locations shown in plate 1].

Well number	Well depth (feet)	Date m/d	Alkalinity	pH, field (units)	Specific conductance, field (µs/cm)	Phosphorus, total	Nitrate, total	Chloride, total	Sodium, total	Potassium, total	Magnesium, total	Calcium, total	Total recoverable (µg/L) lead	iron	copper	manganese	zinc
5	36	04/04	185	7.78	513	0.06	6.0	21	12	1.0	13	78	<500	4400	<50	70	40
11	81	04/05	229	7.53	842	0.53	6.0	108	48	2.2	19	97	<500	6100	<50	70	30
22	45	04/03	173	7.45	610	0.03	4.5	69	34	1.9	12	76	<500	600	<50	<30	0
39	143	04/04	111	8.43	258	0.68	0.80	17	8	0.9	24	80	<500	28,500	<50	800	9,500
40	44	04/04	62	8.00	257	0.18	2.2	30	16	1.4	4.2	32	<500	900	<50	<30	80
47	49	04/05	190	7.76	470	1.29	6.3	27	13	0.9	14	80	<500	<200	<50	<30	60
48	25	04/05	194	7.50	514	0.82	6.6	37	19	0.9	13	82	<500	<200	<50	<30	40
105	59	04/05	168	--	--	0.84	4.6	43	17	1.4	14	77	<500	<200	<50	<30	60
106	75	04/03	139	--	--	0.06	5.7	30	8	1.6	9.4	63	<500	37,300	<50	600	800
108	38	04/03	174	7.50	330	0.02	3.0	29	12	1.2	16	72	<500	<200	<50	<30	1,300
110	100	04/03	239	7.56	623	0.02	2.6	35	12	0.8	25	87	<500	<200	<50	<30	2,000
114	--	04/05	216	7.68	539	0.01	2.4	36	16	1.3	16	87	<500	3400	<50	<30	40
121	32	04/04	219	7.61	673	0.82	5.7	56	27	1.8	17	92	<500	2400	<50	<30	40
170	--	04/03	131	--	--	0.13	4.1	50	26	2.6	24	89	<500	16,900	<50	1,000	50
172	69	04/05	196	--	--	0.43	4.8	28	17	1.0	15	79	<500	<200	<50	<30	50
177	92	04/06	190	7.74	1,440	0.65	4.8	274	204	1.8	16	89	<500	1400	70	<30	70
204	42	04/04	192	7.70	513	1.03	8.6	26	14	0.9	15	73	<500	<200	<50	<30	80
205	26	04/05	231	--	--	0.57	3.9	59	31	2.1	16	89	<500	<200	<50	<30	100
210	45	04/03	220	7.64	518	0.05	3.7	15	6	0.8	18	82	2,300	23,000	70	200	9,200
280	34	04/06	222	7.69	802	0.15	4.6	104	45	2.6	22	110	<500	21,400	<50	300	30
303	28	04/06	164	7.30	668	0.65	4.6	93	46	2.5	11	78	<500	16,500	<50	<30	1,300
304	23	04/04	196	7.68	550	0.55	12.0	31	15	1.1	15	79	<500	<200	<50	<30	20
306	255	04/04	168	8.10	412	0.30	1.4	28	6	1.0	25	80	<500	19,100	<50	300	9,800
307	32	04/03	73	7.44	323	0.04	1.8	43	23	2.0	5.8	38	<500	500	<50	<30	3,300
317	68	04/05	184	--	--	0.56	5.3	31	16	1.0	13	73	<500	<200	<50	<30	20
320	90	04/03	129	7.93	344	0.02	0.76	11	5	0.6	12	49	<500	600	<50	<30	20
330	15	04/05	247	7.25	787	1.14	5.9	80	39	2.7	14	105	<500	<200	<50	<30	30

Appendix 2.--Inorganic chemical analyses of ground water from selected wells in the glacial-aquifer system in Cortland County, New York, April 1990, continued

Well number	Well depth (feet)	Date m/d	Alkalinity	pH, field (units)	Specific conductance, field (µs/cm)	Phosphorus, total	Nitrate, total	Chloride, total	Sodium, total	Potassium, total	Magnesium, total	Calcium, total	Total recoverable (µg/L) lead	iron	copper	manganese	zinc
343	--	04/05	195	--	--	0.65	5.6	37	16	1.1	14	76	<500	<200	<50	<30	0
346	24	04/06	253	7.60	814	1.26	2.2	61	46	3.1	41	241	1,400	46,500	150	3,400	200
347	--	04/05	157	--	--	0.71	0.	34	22	1.5	13	52	<500	1,100	<50	<30	200
348	73	04/03	176	--	--	0.15	8.1	19	28	8.3	124	780	<500	2,200	<50	5,700	100
349	65	04/04	210	--	--	0.64	7.4	24	15	2.9	138	572	<500	21,400	<00	4,,100	200
351	55	04/04	146	--	--	0.28	1.5	61	28	1.9	13	63	<500	2,100	70	90	400
352	55	04/03	154	--	--	0.33	2.5	107	37	1.7	12	70	<500	400	<50	<30	100
353	--	04/06	186	--	--	0.33	4.0	38	23	1.2	14	72	<500	8,200	<50	<30	500
354	--	04/06	160	--	--	0.56	3.4	48	26	1.4	11	68	<500	<200	<50	<30	20
355	63	04/03	163	--	--	0.01	2.8	45	27	1.4	10	69	<500	<200	<50	<30	0
356	57	04/05	196	7.63	589	0.48	4.5	44	29	1.3	15	72	<500	<200	<50	<30	20
357	48	04/05	196	7.57	533	0.12	5.1	26	13	0.90	15	79	<500	<200	<50	<30	0
358	35	04/05	203	--	--	0.40	4.5	31	17	1.1	14	79	<500	<200	<50	<30	50
359	23	04/03	122	--	--	0.05	3.2	66	39	1.9	7.8	53	<500	25,700	70	400	4,400
360	--	04/03	90	--	--	0.08	0.26	5	7	1.3	3.2	47	1,200	60,500	70	1,000	3,200
361	25	04/05	194	7.61	608	0.92	4.1	49	32	1.3	13	78	<500	<200	<50	<30	10
362	67	04/05	203	--	--	1.09	4.3	36	22	1.3	15	81	<500	2200	80	<30	400
363	63	04/03	198	--	--	0.85	5.3	56	24	1.6	15	75	<500	<200	<50	<30	40
364	35	04/04	152	--	--	0.44	0.24	42	20	1.5	14	74	<500	3600	<50	<30	10
365	14	04/03	248	--	--	0.12	0.44	90	46	2.7	26	122	<500	29,200	130	400	300
366	--	04/05	227	--	--	0.68	5.1	101	46	1.6	15	88	<500	<200	<50	<30	20
368	--	04/03	265	--	--	0.09	3.2	232	144	4.7	25	141	<500	19,400	80	500	200
375	--	04/05	187	--	--	0.47	7.2	23	11	0.90	12	79	<500	<200	<50	<30	20
376	--	04/03	137	--	--	0.50	0.	19	51	0.15	1.8	0.1	<500	<200	<50	<30	0
403	54	04/06	192	7.71	638	0.29	4.9	68	35	2.6	11	83	<500	<200	<50	<30	300
406	26	04/03	128	7.66	498	0.05	2.3	19	10	1.0	20	70	<500	6,800	100	1,000	7,800
420	--	04/06	238	7.55	616	0.18	5.5	33	16	1.3	16	91	<500	5,100	<50	<30	20
449	--	04/04	152	--	--	0.56	3.7	16	7	0.70	13	61	<500	<200	<50	<30	30
450	--	04/03	139	--	--	0.40	1.8	61	48	2.1	14	64	<500	19,500	<50	1,000	100

Appendix 2.--Inorganic chemical analyses of ground water from selected wells in the glacial-aquifer system in Cortland County, New York, September 1990.
[Analyses done by the U.S. Geological Survey National Water Quality Laboratory; --, indicates no data available; <, less than; all values are in milligrams per liter unless otherwise noted; µS/cm, microsiemens per centimeter; µg/L, micrograms per liter; well locations shown in plate 1].

Well number	Well depth (feet)	Date m/d	Specific conduct-ance (µs/cm)	pH (units)	Dissolved concentration, in milligrams per liter										
					Alkalinity	Nitrite plus nitrate as N	Phor-phous, ortho as P	Cyanide	Calcium	Magne-slum.	Sodium	Chloride	Sulfate	Fluoride	Silica
5	40	09/19	--	--	224	9.9	<0.01	--	--	--	--	40	19	0.1	--
11	81	09/19	--	--	223	5.0	<0.01	--	--	--	--	79	24	0.1	--
22	45	09/20	631	7.8	189	7.6	<0.01	--	79	13	34	--	--	--	6.3
48	25	09/17	568	7.5	220	6.4	<0.01	<0.01	87	14	16	--	--	--	7.4
105	59	09/17	554	7.8	175	4.9	<0.01	--	76	14	18	--	--	--	7.3
106	75	09/19	--	--	166	6.9	<0.01	--	--	--	--	21	17	0.1	--
108	38	09/17	--	--	300	6.0	<0.01	--	--	--	--	38	25	0.1	--
121	32	09/20	546	7.7	181	5.9	<0.01	--	75	14	20	--	--	--	7.2
172	69	09/18	559	7.6	206	5.3	<0.01	--	79	15	14	--	--	--	7.4
177	92	09/19	1390	7.8	200	4.1	<0.01	--	74	14	170	--	--	--	7.5
204	46	09/17	--	--	197	4.6	<0.01	--	--	--	--	30	24	0.1	--
207	53	09/17	--	--	151	8.3	<0.01	--	--	--	--	29	23	0.1	--
210	45	09/17	413	7.7	--	--	--	--	61	14	4.8	--	--	--	7.5
280	34	09/19	807	7.7	204	4.7	<0.01	--	87	17	56	--	--	--	7.8
303	28	09/17	--	--	214	3.7	<0.01	--	--	--	--	72	25	0.1	--
304	23	09/17	--	--	226	4.0	<0.01	--	--	--	--	34	23	0.1	--
317	68	09/18	558	7.6	205	5.7	<0.01	--	78	15	14	--	--	--	7.6
320	90	09/20	363	8.0	140	1.7	<0.01	--	53	13	4.8	--	--	--	8.7
321	80	09/17	3,850	7.2	271	3.0	<0.01	--	230	39	530	--	--	--	10
330	15	09/17	651	7.4	218	6.5	<0.01	<0.01	89	12	31	--	--	--	6.8
332	34	09/18	815	7.7	230	0.7	<0.01	--	100	18	35	--	--	--	8.3
333	55	09/18	565	7.7	211	4.2	<0.01	--	77	16	16	--	--	--	7.8
335	34	09/18	854	7.7	255	5.1	<0.01	--	91	18	59	--	--	--	8.5
337	42	09/19	533	7.6	201	6.5	<0.01	<0.01	81	14	11	--	--	--	7.4
338	217	09/19	288	8.9	104	0.1	<0.01	--	13	6	42	--	--	--	0.55
339	35	09/18	584	7.7	200	5.4	<0.01	--	83	14	20	--	--	--	6.5
340	35	09/19	763	7.8	224	3.6	<0.01	--	98	17	34	--	--	--	8.7
341	137	09/19	716	8.0	111	0.1	<0.01	--	32	14	86	--	--	--	1.4
342	52	09/17	610	7.8	176	3.7	0.02	--	72	14	33	--	--	--	7.6
343	24	09/20	662	7.8	252	0.7	<0.01	<0.01	89	19	22	--	--	--	7.8
346	24	09/19	823	7.5	225	1.6	<0.01	--	92	16	52	--	--	--	8.5
347	--	09/20	--	--	193	2.8	<0.01	--	--	--	--	--	--	--	--

Appendix 2.--Inorganic chemical analyses of ground water from selected wells in the glacial-aquifer system in Cortland County, New York, September 1990, continued

Well number	Well depth (feet)	Date m/d	Specific conductance (µs/cm)	pH (units)	Dissolved concentration, in milligrams per liter										
					Alkalinity	Nitrite plus nitrate as N	Phorphous, ortho as P	Cyanide	Calcium	Magnesium.	Sodium	Chloride	Sulfate	Fluoride	Silica
348	73	09/18	492	7.9	174	--	--	--	--	--	--	--	--	--	--
349	65	09/18	571	7.7	211	--	--	--	--	--	--	--	--	--	--
351	55	09/20	594	7.8	--	--	--	--	77	13	23	--	--	--	6.4
352	55	09/20	613	7.9	--	--	--	--	56	13	44	--	--	--	3.9
355	63	09/19	505	7.9	158	3.3	<0.01	--	61	10	24	--	--	--	5.7
356	58	09/18	--	--	199	4.0	<0.01	--	--	--	--	--	--	--	--
357	48	09/18	--	--	197	5.3	<0.01	--	--	--	--	--	--	--	--
358	35	09/18	--	--	231	4.4	<0.01	--	--	--	--	--	--	--	--
362	67	09/20	614	7.6	--	--	--	--	79	15	21	--	--	--	7.3
363	63	09/20	--	--	194	4.6	<0.01	--	--	--	--	57	23	0.1	--
364	35	09/20	633	7.7	199	4.7	<0.01	--	83	16	23	--	--	--	7.2
365	14	09/17	820	6.9	312	0.3	<0.01	--	110	17	45	--	--	--	14
366	----	09/20	--	--	209	3.5	<0.01	--	--	--	--	70	22	0.1	--
367	----	09/20	--	--	200	5.5	<0.01	--	--	--	--	--	--	--	--
368	----	09/17	1130	7.2	--	--	--	--	100	14	110	--	--	--	6.9

Appendix 2.--Inorganic chemical analyses of ground water from selected wells in the glacial-aquifer system in Cortland County, New York, September 1990, continued

Well number	Dissolved concentration, in micrograms per liter																
	Arsenic	Barium	Beryl-ium	Cadm-ium	Chrom-ium	Cobalt	Copper	Iron	lead	Mang-anese	Molyb-denum	Nickel	Silver	Stron-tium	Vanad-ium	Zinc	Lithium
5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
22	--	58	0.5	1	<5	<3	<10	33	<10	17	<10	<10	<1	110	<6	4	7
48	1	29	0.5	1	<5	<3	<10	6	<10	1	<10	<10	<1	110	<6	24	7
105	--	49	0.5	1	<5	<3	<10	3	<10	2	<10	<10	<1	110	<6	62	8
106	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
108	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
121	--	66	0.5	1	<5	<3	<10	13	<10	12	<10	<10	<1	120	<6	15	13
172	--	61	0.8	1	<5	<3	<10	23	<10	15	<10	<10	<1	110	<6	36	9
177	--	57	0.5	1	<5	<3	20	12	<10	6	<10	<10	<1	140	<6	35	14
204	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
207	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
210	--	73	0.5	1	<5	<3	<10	12	<10	42	<10	<10	<1	92	<6	430	7
280	--	87	0.5	1	<5	<3	<10	37	<10	2	<10	<10	<1	140	<6	7	10
303	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
304	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
317	--	63	0.5	1	<5	<3	50	14	<10	11	<10	<10	<1	100	<6	4	9
320	--	71	0.5	1	<5	<3	<10	4	<10	4	<10	<10	<1	91	<6	5	10
321	--	290	1.5	3	15	9	30	11	30	4	30	30	4	400	18	9	23
330	1	35	0.5	1	<5	<3	<10	10	<10	2	<10	<10	<1	120	<6	28	6
332	--	75	0.5	1	<5	<3	<10	10	<10	790	<10	<10	<1	200	<6	9	16
333	--	50	0.5	1	<5	<3	<10	32	<10	250	<10	<10	<1	110	<6	3	9
335	--	69	0.5	1	<5	<3	<10	95	<10	270	<10	<10	<1	170	<6	13	11
337	1	53	0.5	1	<5	<3	<10	19	<10	26	<10	<10	<1	110	<6	3	7
338	--	120	0.5	1	<5	<3	<10	41	<10	33	<10	<10	<1	400	<6	5	29
339	--	38	0.5	1	<5	<3	<10	15	<10	12	<10	<10	<1	120	<6	6	5
340	--	72	0.5	1	<5	<3	<10	9	<10	64	<10	<10	<1	150	<6	7	10
341	--	210	0.5	1	<5	<3	<10	62	<10	65	<10	<10	<1	390	<6	9	240
342	--	42	0.5	1	<5	<3	<10	280	<10	200	<10	<10	<1	110	<6	15	9
343	1	62	0.5	1	<5	<3	<10	5	<10	580	<10	<10	<1	150	<6	16	8
346	--	87	0.5	1	<5	<3	<10	17	<10	94	<10	<10	<1	130	<6	8	10
347	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
348	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
349	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Appendix 2.--Inorganic chemical analyses of ground water from selected wells in the glacial-aquifer system in Cortland County, New York, September 1990, continued.

Well number	Dissolved concentration, in micrograms per liter																
	Arsenic	Barium	Beryl-ium	Cadm-ium	Chrom-ium	Cobalt	Copper	Iron	lead	Mang-anese	Molyb-denum	Nickel	Silver	Stron-tium	Vanad-ium	Zinc	Lithium
351	--	51	0.5	1	<5	<3	<10	6	<10	3	<10	<10	<1	110	<6	72	8
352	--	47	0.6	1	<5	<3	<10	18	<10	27	<10	<10	<1	100	<6	91	8
355	--	43	0.5	1	<5	<3	<10	7	<10	1	<10	<10	<1	85	<6	11	7
356	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
357	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
358	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
362	--	59	0.5	1	<5	<3	<10	580	<10	14	<10	<10	<1	110	<6	120	11
363	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
364	--	61	0.5	1	<5	<3	<10	730	<10	20	<10	<10	<1	120	<6	4	9
365	--	150	0.5	1	<5	<5	40	7900	30	3600	<10	<10	<1	190	<6	210	12
366	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
367	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
368	--	71	0.5	2	<5	<3	<10	17	<10	4	<10	<10	<1	150	<6	8	9